MACHINERY.

VOL. 4. September, 1897. No. 1.

SOME NOTES FROM AN ENGLISH SHOP.

JAMES VOSE.

THE firm of Meldrum Bros. carry on business at Atlantic Works, City Road, Manchester, the premises having formerly been occupied by Messrs. George Richards & Co., makers of the well-known Richard's side planer. The Meldrum shops, though not large, are generally considered interesting by visitors. About 60 men and boys are employed in the machine shops, and a good number are kept at work in the moulding shops of outside firms. It is not practicable for them to have their own foundry in the present situation of the works.

The original idea of the firm was to make a specialty of steam and other jet apparatus, such as ejectors, elevators, blowers exhausters, etc. A sound and increasing business was being developed on these lines, when, in consequence of the increased attention being given to the utilization of what were formerly considered "waste fuels," the "Meldrum" furnace was designed and put on the market. This has since held a leading position in its own special line, and has, in fact, brought into prominence a special branch of engineering, viz., the construction of furnaces for different purposes, so that now it is not uncommon to see firms describing themselves as "furnace engineers." The development, manufacture and sale of the "Meldrum" furnace has been such as to completely overshadow, in extent, the other jet apparatus part of the business, though that is still carried on.

DESCRIPTION OF WORKS.

The building itself is about as unsatisfactory as could be devised, it being almost a triangular shape, and from cellar to top room is six stories high. The private and drawing offices are equipped with a capital supply of technical works of reference on most branches of engineering, and are provided with telephones to various parts of the works. In connection with the drawing room is a well appointed laboratory for fuel testing. The last named feature is of great service in arriving at the probable saving to clients to be effected by using low class fuels, by means of the firm's furnace.

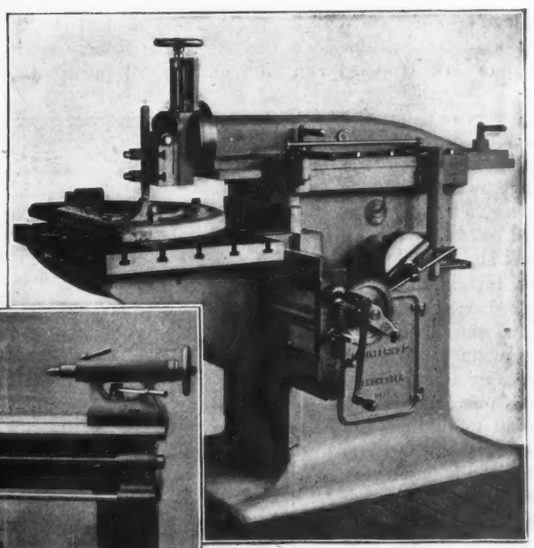
One redeeming feature about the works is that the light is good in most of the rooms. The whole premises, however, are becoming altogether too small and unsuitable for the present and prospective volume of business, and the lines on which it is desired to do the work. It is intended, in consequence, to remove to the outskirts of the city, an intention at present shared to a noticeable extent by other Manchester engineering firms.

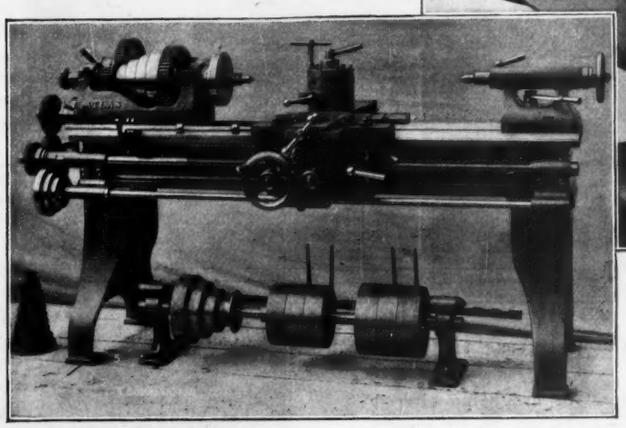
SHOP METHODS.

Regarding the tools used in the manufacture of the furnaces, it may at once be said that they are not highly specialized, *i. e.*, they are quite as useful for all-round work as for their own regular work. This results from the fact that the greater part of the work belongs to that awkward class that is made in two small quantities to justify the buiding of very special tools, and yet is made in too large quantities to rest content with ordinary tools and methods. The question resolves itself into a matter of taking the ordinary tool as a basis of operations, eliminating any objectionable or weak features which have come to light in previous working, and adding or perfecting details which facilitate special operations.

This policy has proved highly successful, though it will be understood that highly specialized tools would be obtained at once should the quantities required justify it. Constant watch is kept on tool development on both sides of the Atlantic, and no partiality is shown in the matter of where tools are purchased. It may be broadly stated that the heavier tools are principally of English make, and the smaller tools and conveniences of American origin.

One noticeable featnre in the shop's methods is the amount of

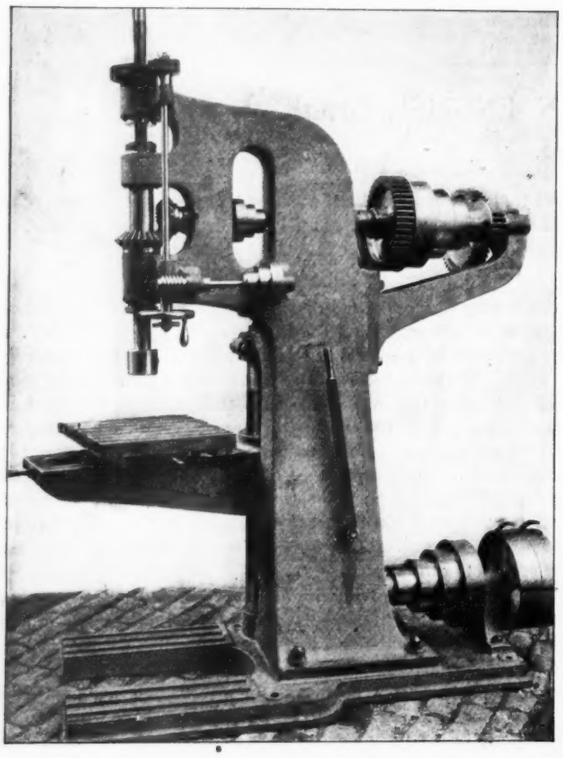




SOME ANGLO-AMERICAN TOOLS. FIG. I.

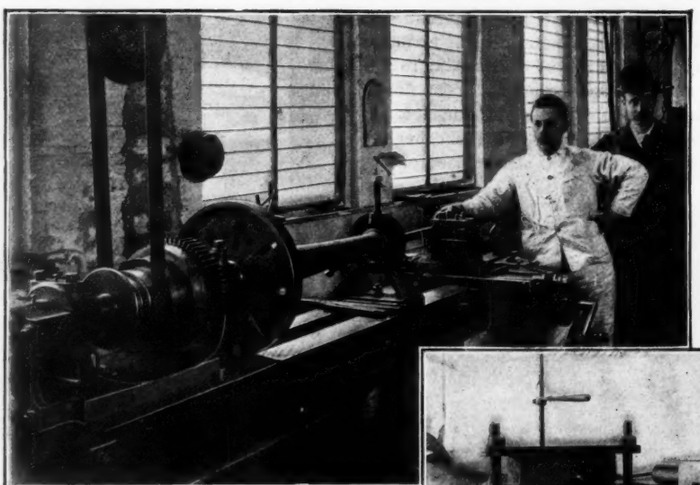
lathe work. From the beginning the advantages of circular tooling were recognized, and the work designed as far as possible to be tooled in the lathe. Also, the joining together of parts of work finished in the lathe is, to a great extent, by means of screw threads. The threads used are all gas threads, only four sizes being employed, *i. e.*, 26, 19, 14 and 11 threads per inch, which are made to agree with the standard diameter of gas threads. These fine threads are often used where bolt or some special threads would be used by most firms; as by this means the number of gauges, etc., can be kept at a minimum. Also, a greater number of small parts can be made to work in with ordinary commercial fittings, and do not require

to be specially made. This feature of gas threads has often been serviceable in unexpected ways. For instance, the outside of a chuck for a drill press was screwed 2-inch gas thread, with no



A YORKSHIRE DRILL PRESS. FIG. 3.

mmediate object in view except that there seemed the foundation of future usefulness in the idea. Later on, the shaping machine being crowded with work, and the drill press being idle, a 2-inch steam flange was screwed on the chuck, a turning tool was cramped on the flange by the usual bolt holes, a shaper vise fixed on drill press table, and as the table was rectangular and worked on a slide by a screw, the drill press was made to do some very fair surfacing. This principle is extended to milling and other machine spindle noses and is found very handy, as, by means of the reducing threaded sockets or sleeves used on the lathes, other sizes can be accommodated without making special chucks.



BORING A BLOWER TUBE. FIG. 4.

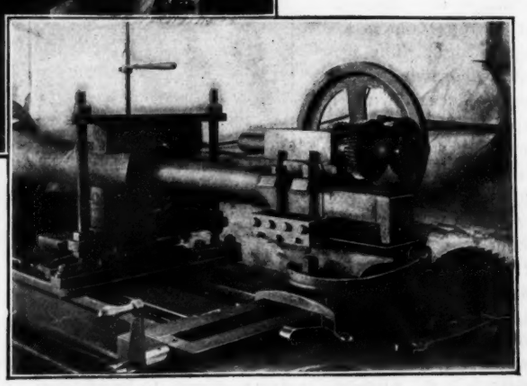
All the lathe spindles have Morse taper bores for the centers, or are being altered to this taper. This is found most convenient, as by means of the Morse reducing sleeves the largest lathe can use the smallest drill, and does not need to be supplied with a full set of drills, etc., as they can be borrowed from a drill press or another lathe. The taper (as a taper) may not be the best, but I feel sure it is the handiest and most serviceable taper, taken all around, as so many articles besides drills can be used without alteration. Many old drill shanks can be used up for special centers, chucks, etc., and in the cases where a center has to reach a center hole in a deep recess, which is too small to take the ordinary diameter of center, the reducing sleeve and smaller center can be used. On the whole, one can only realize the advantages of this taper when he has worked on a lathe thus equipped and is transferred to another lathe not so provided. The same thing applies to drill presses and milling machine spindles. As only four threads are used, exclusive of bolt threads, there is no need of lathes being arranged to have so many different threads at command, as in the recent prominent American builds, and therefore it suffices to have lathes built with the four usual threads ready for use, and the lathe still be fully competent to cut any thread that can be required, from, say one thread in four inches to 70 or 80 per inch.

SOME ENGLISH MACHINE TOOLS.

The illustration, Fig. 1, shows a tool built by the Atlas Engineering Company, Manchester, to which the above arrangement can be added to suit any customer's requirements. A photograph of the lathe with the arrangement is not at present obtainable, but it may be said that the wheels required for the regular four threads are under the headstock and can be brought into use as required by a lever handle in front, and by means of a small toothed clutch the ordinary screw cutting arrangement can be brought into action, the movement of the clutch throwing the variable arrangement *out* of action. This lathe is interesting as an example of a combination of English and American practice. The bed has the inverted Vs; the headstock is of American type, the tailstock English type, the carriage and slide rest English type. A six-tool turret is arranged to go in place of the slide rest when required. The live spindle is hollow, the steady rest is of the hinged three jaw American type, and the apron is of a modified American type. As a whole it is generally regarded as a good example of utilizing the good points of English and American practice.

The Atlas Company build tools on both English and American lines to suit the purchaser's requirements, one of their lines being friction shapers. One of these machines, shown in Fig. 1, has been doing good, hard work the last few years on furnace fronts, etc. It will be seen that the table is much larger than is usual on a shaper, and has a longer traverse. In fact, it is really acting as a planer, and is specially used in preference to the regular planer, as this class of work can be more readily fixed and manipulated on a shaper than a planer. A still larger capacity of machine is in contemplation.

One feature of the planing, milling and drilling machine tables in use at the Meldrum shops is, that the T slots on the table are made large enough to take standard size, ordinary bolt-heads of commerce, without each bolt head having to be thinned. This is one of the places where the convenience of manipulation of the



ATTACHMENT FOR DRILLING FLANGES. FIG. 5.

maker and user do not always coincide, but slots of standard size are insisted on by the users in this case. A Richards screw-driven shaper is also in use (as illustrated in your issue of May, 1895).

A 24-inch drill press, built on American lines by the same firm as the first mentioned tools, is a handy tool. As shown in Fig. 2, this page, the ratchet lever feed, which is the usual American practice, is replaced by a pilot wheel, which is generally considered in England as better practice than the single lever. I am not quite decided in my own mind whether a

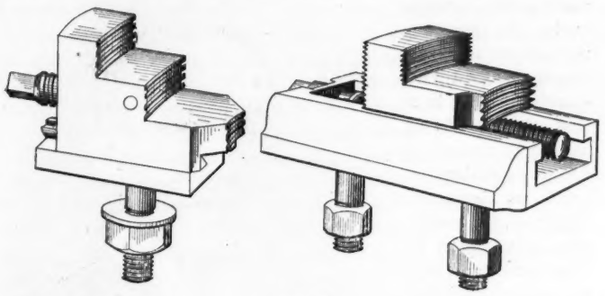


FIG. 6.

light hand wheel of same diameter as the radius of pilot wheel spokes would not be better still for most classes of work. The hand wheel is certainly preferred by British users on the tail-stock spindle of lathes and on the transverse feed screw of slide rests, as compared with the American balanced handle. By an arrangement added by the users, the drill press is used for tapping. As will be seen, the top cone shaft is fitted with fast and loose pulleys and a belt shipper. The tap is gripped by the corners in an ordinary drill chuck. The spindle being released from the gear feed, the tap is brought down to the work, the spindle revolved the ordinary way and the hole thus tapped. The driving belt is then shipped onto the loose pulley and the small belt on top shaft brought into use, thus reversing the spindle at a quick rate. Though only an expedient, it compares fairly with an ordinary tapping machine, for which there would not be sufficient work.

Among other machine tools in the shop we may notice a 10-inch swing lathe by Messrs. Tangye. This was the first tool used in the shop, and is still in capital condition. It is a most serviceable tool, every part seems to be handy to the operator and to be nattily proportioned, yet of ample strength. The live spindle has a specially good arrangement of conical necks, by which each neck can be adjusted separately, and the lathe on the whole has scarcely seemed to develop an unsatisfactory feature, during the whole time of its use, though in appearance it seems nothing out of the ordinary. There are several lathes by Butterworth, who was some years ago a well known Manchester maker. In these lathes the surfacing motion is worked from the leading screw, which is also used as a rack. These tools were designed as a good, simple tool at a moderate price, and enjoyed a good reputation up to the time of the firm discontinuing operations. There are two lathes and a sensitive drill press by Spencer & Co., Hollinwood, Manchester, which are interesting examples of good medium tools. It is easy to see on inspecting them that much thought has been bestowed on the design so as to give a really serviceable tool at a moderate cost. No surface is tooled or polished unless it is actually needed for the good working of the lathe, and the various castings are pleasant to look at, as there is scarcely a sharp corner in the design, every edge being suitably rounded. There is a fair sprinkling of "Yorkshire" tools, some of which have been of great service.

A type of drilling machine, which I have seen no counterpart of in American practice, is here shown in Fig. 3. The arm carrying the table swings on a side pillar, the table revolves on its own axis, and has also a longitudinal traverse. Thus for many purposes the machine is as handy and of as great range as a radial drill. These are "Yorkshire" tools, and one in use in the Meldrum shops is arranged with reverse motion, balanced spindle, etc., and will drill, countersink, face and tap a 1½-inch gas hole, 1 inch deep in hard cast iron, at a labor cost of about one cent. Such a tool capable of drilling to the center of a 36-inch circle will cost about 250 to 265 dollars. Makers of this class of tool make no claim to special accuracy, but rely for their sale on price, range and power.

A FEW FIXTURES AND APPLIANCES.

Several lathes are in constant use boring the cylindrical parts of the blower tubes. (See illustrations 4 and 5). A cast iron bar is fitted on the slide rest and a self-hardening steel cutter secured by a set screw is used. The methods of cramping and staying will be noted. These give as good and quick results as the most elaborate fixings. In the small view will be seen a drilling attachment laid loosely on top of the boring bar, to show where it is fixed when in use. Some special blowers have to be drilled on the flanges, which are too tall to be drilled under any usual drilling machine. The drilling attachment is put on the slide rest in place of the boring bar, and driven by means of a rope from the countershaft. The rope passes over guide pulleys, in swing frames, and therefore allows the drill to be moved along the bed, or transversely on the carriage, so that the drill has a very useful amount of movement. Tension is applied to the rope by a counterweight. The feed is by hand through the slide rest. The down belt of the lathe is pulled off while drilling the blowers, and the blower is turned round in the stay to the next hole after one is drilled. By reversing the two small spur wheels (whose hubs are handle shaped) two speeds can be given to the drill. The countershaft can also give two speeds. It is found a very handy attachment indeed, as the flanges can be drilled in less time

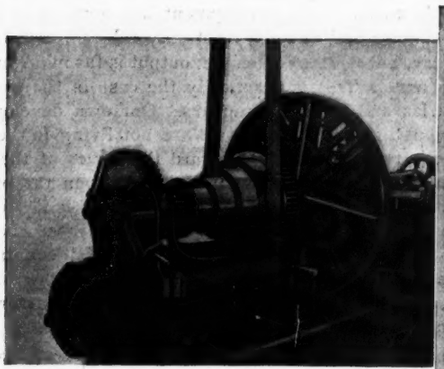


FIG. 7.

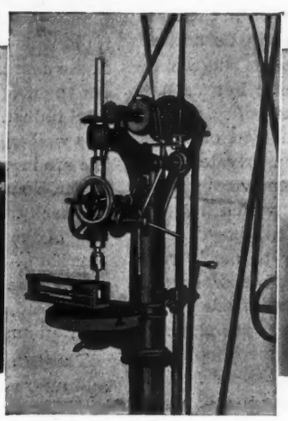


FIG. 2.

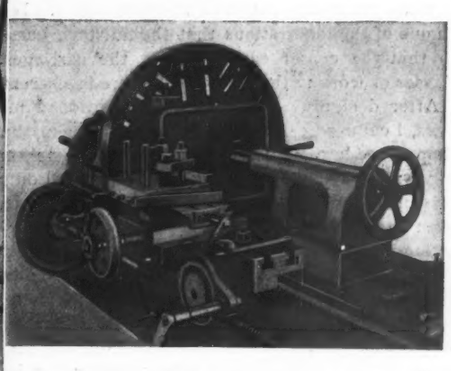


FIG. 8.

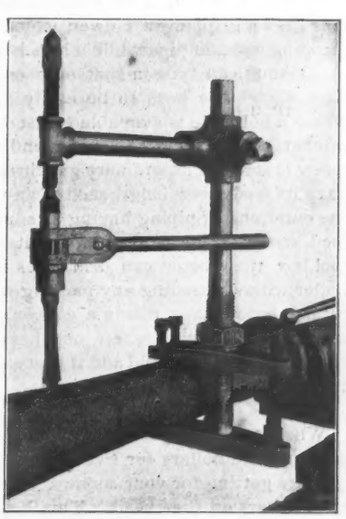


FIG. 9.

than the blower could be moved from the lathe and fixed in a pit under a drill press in the manner usual in shops where the floor will allow the use of a pit.

The most recent lathes have the three feeds put in gear by a lever in front of lathe, mentioned by Professor Sweet as being in use in Lang's Glasgow shops, in an article appearing in your number of January, 1896. As far as possible, each machine tool has its complement of tools provided before starting up, so that the tool goes straight to business. This plan saves much worry and delay in the first few weeks of the tool's working.

In place of the usual jaw chucks on lathes, independent jaws are preferred in conjunction with the ordinary face-plate. The style in use is "Barber's," of Hastings. This firm make a specialty of loose face-plate jaws, or "dogs," shown in Fig. 6. In the Meldrum shop the backs of the face-plates are serrated at each side of the slots, the teeth being of buttress shape. A correspondingly toothed plate or washer is drilled to suit the diameter of stud, which draws the jaw against the face-plate. When each jaw has been roughly set to position, the nut of the stud is tightened and the two sets of teeth lock the jaw positively to the face-plate. The final adjustment is by means of the usual jaw traversing screw. It will be seen from the illustrations of the lathe (Figs. 7 and 8), which show back and front of face-plate, that the jaws need not be radial, but can adjust themselves to any angle, are positively fixed when in use, and yet easily moved from top to bottom of slot, thus saving the tedious winding up or down of the usual jaw chuck. Of course the usual jaw chuck has its strong points, but they do not show up in the class of work principally required in these shops. It will be noticed on one of the illustrations that the tailstock barrel is lengthened so that the center can overhang the carriages. For certain classes of work in the shop this feature is of great utility.

After designing the previously mentioned method of fixing jaws, I came across an old lathe, formerly in the private workshop of the late Mr. John Hick, head of the well-known engineering firm of Hick, Hargreaves & Co., of Bolton, which had the face-plate serrated *in front*. This arrangement, however, is open to the objection that the teeth are likely to mark work which may require to be held against the face-plate, where the use of jaws is inadmissible. Loose strips are now on sale by one or two firms, for fastening on the backs of existing face-plates so as to convert them to the above system. The same people also supply face-plates with the teeth cast on, and jaws to suit. This combination forms a cheap substitute for the jaw chuck, where the amount of chuck work will not justify the purchase of the regular jaw chuck.

Much of the comfort of men working outside the shop, and also the often necessary quick erection of the forced draught furnace, depends on a good kit of tools being provided. Special attention has been paid to this point, with good results. The illustration, Fig. 9, shows a very handy and substantial drilling jib. It is shown gripping a blower, which indicates its capability of gripping a steam pipe while a hole is drilled. It differs from the usual American type in that only one loose plate is employed. This allows the base to be easily fastened to any flat object, where a bolt hole is available (twist drills are mostly used in the ratchet braces). On the outer end of the ratchet brace feed-screw is screwed an ordinary gas thread. The brace can thereby have its feed screw lengthened to any extent by means of piping, the outer end of piping having a reducing socket which carries a feed screw. By carrying two suitable lengths of pipe in the tool box, the erector can drill holes in the flues of any ordinary boiler without needing any packing whatever. As one maker of ratchet braces says, this is a convenience more beneficial to the user than makers, as where one buyer would pay 25 cents extra for this device, 99 would add it themselves to their braces already in use.

* * *

When some peripatetic individual comes around offering to sell you gold dollars for twenty-five cents, you look to see what you are getting for your money. Men are not given to selling gold dollars on that basis. This holds just as good in machinery as in dollars. Always see that you get what you are paying for, and never think you are getting a thing cheap because you are getting it for little money.

* * *

It is stated that the Germans exported 2 800 000 pounds of needles in 1897. What became of them?

HOW TO DEVELOP OUR MACHINERY TRADE ABROAD.

Charles Davis.

We are in receipt of your request for a word on the foreign trade. In this connection we are constantly asked the question, Why is it that the leading manufacturing countries of Europe, such as Germany, England, Sweden, etc., have been so busy and the trade in the United States for the corresponding period so dull?

Two reasons may be advanced.

The first is that in the past we have been occupied in developing our own country and were able to absorb all and more than we could make. This development has gone on at such a rapid pace that we find ourselves not only fully up to the needs of the country, but in many lines our output is far in advance of our requirements. This is practically the case in the iron and steel industries and kindred branches. Our own development was well enough for the time, but we are not living in the past. We are in the to-day, and must regard the issues of the hour. In the eloquent words of Balzac, "We stand upon the present and seek to dominate it, and if we destroy the past it is for the sake of the future." To keep in touch with the most advanced thought of the age, we must broaden out and let all countries be our field and absorb our surplus. Some one has suggested as our motto, "America for the Americans." This is narrow; we offer an amendment, *The World for the Americans.*

This brings us to our second reason: The lack of attention and interest in the export trade on the part of the manufacturers at large in the Uuited States. This cannot, however, be said of the machine tool builders. They have been prompt to recognize the state of affairs abroad, and in consequence have been enabled to run to their full capacity for the past two years.

Most of our tool builders have been abroad and have investigated the trade conditions that obtain in Europe, therefore any suggestions that may be offered here will naturally be for the benefit of other lines. It remains for other manufacturers to earnestly and systematically investigate this foreign trade. It may be like machine tools: their output will be taken in Europe just as it is, and no doubt like machine tools also, be found much superior to European makes. If not, then modifications can be made to suit the demand. It may be taken as a general axiom in business, that more money can be made supplying a legitimate demand than trying to create one. Some member of the firm or officer high in authority should personally make this investigation. It should be one who can *make conditions;* not simply a salesman, who is made by them.

Beware of syndicate travelers, representing several lines. A man must be above the average to properly represent one line, to say nothing of several. Should he make a success of one, it will invariably be found to be at the expense of the others.

It is true, the cost to each is little, but it may also be taken as an axiom, *What costs but little in business is worth but little.* Do not fall into the popular error of giving the exclusive agency of Europe to some one in England. You might as well give the agency of Massachusetts to some one in Oregon.

Remember there are prejudices, political and otherwise, that might materially hamper your future transactions, if several countries are embraced in one agency.

Find the leading trade center in each country in your particular line and let it be your headquarters in that country. If the article to be placed is of universal consumption, then several sub-agencies may be found valuable. In Great Britain, for instance, an agency might be desirable in London, Manchester and Glas-

gow. The same may be advanced for Northern and Southern Germany, also for the north, south, west and central parts of Russia, such as St. Petersburg, Odessa, Moscow and Warsaw, in Polish Russia.

For obvious reasons an agency for Germany should not be given to France, or the reverse. As a general proposition, don't grab at the first bait that may be thrown and tie yourself in a hurry and repent at leisure. After going the rounds you will feel like the man who tried to pick a fly off a mule's hind leg. He said he "never was so pretty afterwards, *but he knew more.*' You will be met at the outset in all countries by a request for a consignment. There may be a variety of views on this subject, but cash and short-time notes are good enough for us.

The great demand for machine tools has enabled our manufacturers to sell mostly for cash or on very short time. As trade in nearly all European countries is now on a boom, this state of affairs may be found to exist in other lines, and equally advantageous terms may be obtained. Don't be in a hurry to close. Remember the old saying, "There are others."

For a general line it might be well to be liberal in the first bill, but have a definite time agreed upon for settlement, by acceptance running from date of steamer bill of lading. Let your terms be F. O. B. steamer dock, New York, and your responsibility ceases there for loss or breakage. This is important, as the steamship companies handle boxes like prize-fighters, and you will be in hot water all the time if you attempt to father the breakage. There are insurance companies on the other side that take these risks. Your customers can patronize them. Nine-tenths of all the breakage occurs in loading and unloading the steamers. Never watch a steamer loading your stuff, otherwise you will not sleep until you get your money for the goods.

If you are selling intricate machinery, it is well not to guarantee a given output for the machine. You will have to contend with two difficulties. First, unskilled operatives, with an inherent prejudice against new machines. Secondly, they have not yet reached a stage where raw material, such as cold rolled steel, is manufactured for a specific purpose, as with us.

When a guarantee is insisted upon, we stipulate, that should the party be unable to turn out as much as represented, we agree to send a man with material from the United States. Should he perform what we claim, his salary and all expenses must be paid by the customer. If he fails, we are to pay his salary and all expense and take out the machine. Happily we have not as yet had to do either. Something like the married man and the typewriter, "his wife never caught him, but very near it."

Commercial agencies are comparatively unknown in Europe. It is wise, therefore, to take a letter of introduction to the banks in the larger cities. Much importance is attached to these letters among banks. Commercial honor stands high in Europe, with but few exceptions. It has been our experience that in the main only truthful representations are made by the merchants as to their financial worth.

No hesitancy need be felt on account of being unable to speak the different languages. The trade language of the world is English. The proprietors of nearly all large concerns in France, Belgium, Germany, Austria, Sweden, Norway, Finland and Russia, all speak English fluently. Having established an agency, the smaller places can be visited by your agent, who can conduct the negotiations if necessary.

In addition to the regular letter of credit, a great accommodation will be found in carrying several hundred dollars worth of American Express company's checks, in denominations of $20.00 each. In these it states in figures how many pounds, shillings, francs, marks, kroners, etc., you are to receive for your $20.00. No advantage whatever can be taken of you. They can be cashed at all the leading hotels. Having been busy the entire day, you have perchance forgotten to procure money on your letter of credit at bank. If you did not have the $20.00 checks referred to, you would have to remain over another day. For this and many other reasons they will be found of great advantage.

The leading manufacturers of the United States owe it as a duty to themselves, to immediately investigate these foreign markets. They will find it "Bread cast upon the waters."

Do not be intimidated by the cry of "cheap labor." As stated above, what is so cheap is worth but little. Skilled labor and brains are bound to tell in the end. It was my good fortune to meet many superintendents and foremen from the United States, who are receiving more money than they made here. The law of supply and demand rules there as everywhere. They are now recognizing the superior skill and inventive genius of the American mechanics, and must have them without regard to cost, as the heads of departments. Brains, like the large potatoes in the wagon, will always work to the top.

The question is asked, Has this trade with Europe come to stay? We believe that it has, if we watch it closely and keep abreast with its conditions. In some lines it may not continue with the fierce ardor of the past two years, but in those lines, if good seed has been sown, it will bring the desired harvest—slowly, perhaps, but surely.

All European countries look upon an export trade as the best solution for working off a surplus. It is well known that a factory can be operated to better advantage if run to its full capacity, with half its output sold at a very small margin, than if run half time with a larger margin on all sales. By the first method the proportion of administration expense is greatly lessened.

If the manufacturers of the United States will seriously engage in the export trade, mainly along the lines that have made them so successful in this country—if they will but exert the old-time energy and the inventive genius that is latent in them, if they will bring their united influence to bear on Congress in behalf of American ships, we predict that the American flag will again be found on every sea at the mast-head of our merchant marine, and the output of our workshops, our looms and our factories will force to the wall the production of the cheaper labor of Europe.

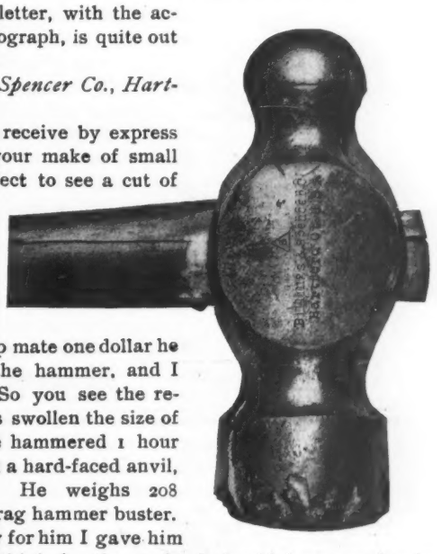
* * *

THE FEAT OF A "HAMMER BUSTER."

The following letter, with the accompanying photograph, is quite out of the ordinary:

The Billings & Spencer Co., Hartford, Conn.:

SIRS: You will receive by express prepaid one of your make of small hammers. I expect to see a cut of it in the near future to show the workmen that no other hammer will stand this test. I bet a shop mate one dollar he could not bust the hammer, and I stand the loss. So you see the results. His arm is swollen the size of a man's leg. He hammered 1 hour and 47 minutes on a hard-faced anvil, without a rest. He weighs 208 pounds and is a brag hammer buster. Now in sympathy for him I gave him the dollar, and I think for the "ad." I should have another in its place. All hands say their next hammer will be a Billings & Spencer. Hoping to receive a new hammer soon, will remain



Yours truly, C. P. KENTON,

Anderson, Ind., June 10, 1897.

* * *

BY Congressional enactment, approved February 18, 1897, the maps and atlases of the United States made and published by the geological survey of the Government, must be disposed of through sale. They are prepared from actual surveys, and show surface elevations, roads, and all necessary physical details. Each sheet is designated by the name of a principal town or some prominent natural feature within the district, is 16½ by 20 inches and covers one-sixteenth, one-quarter, or the whole of a geographical degree according as the scale is one, two, or four miles to the inch, the scale varying with the character of the country. About 900 such sheets have been printed. They will be sold at the rate of five cents per sheet. Orders for one hundred sheets or over, whether for the same or different sheets, will be sold at the rate of two cents per sheet. Proportional charges will be made for the larger size and special maps.

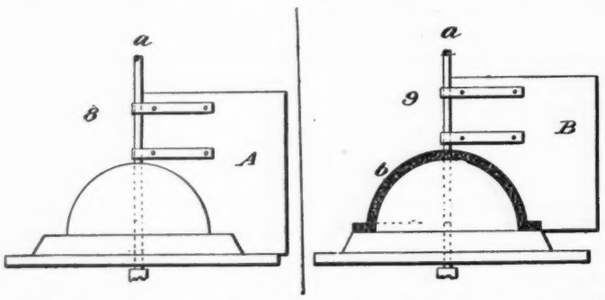
Lists of maps and folios and other publications of the survey will be furnished on application. Remittances must be by money order made payable to the Director of the United States Geological Survey, or in currency (at sender's risk) for the exact amount. Stamps and checks cannot be accepted.

PRACTICAL PATTERN MAKING.—4.

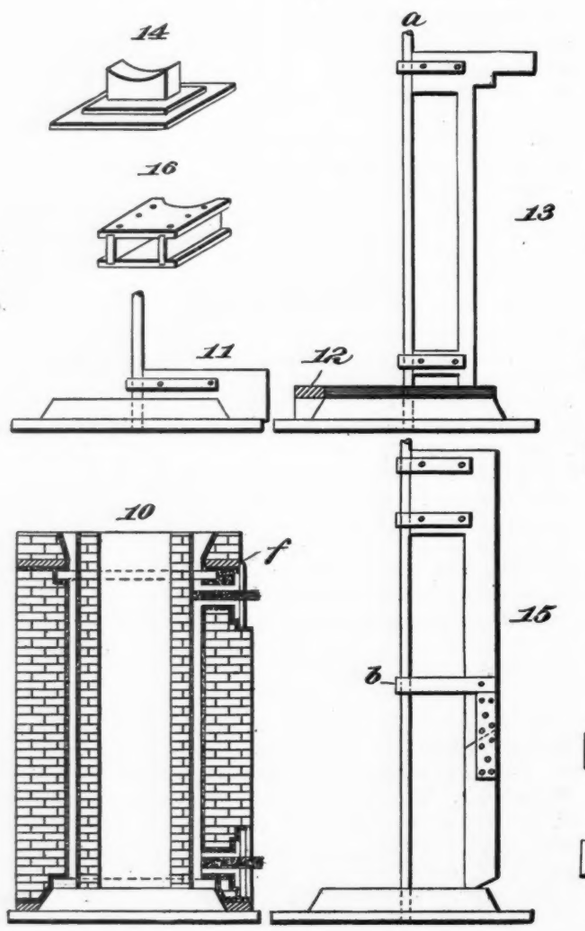
I. McKim Chase.

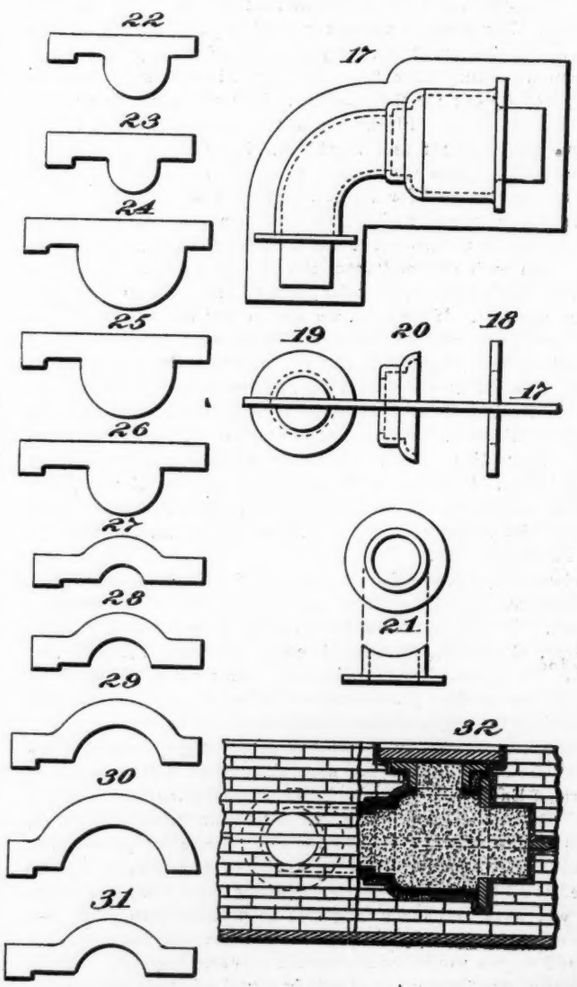
PATTERN WORK FOR MOULDING IN LOAM.

The present series of articles have not been written with the view of teaching the art of pattern making, but rather presupposes a knowledge of it; proficiency must be acquired by practical work, patient application and the stimulus of ingenuity, at the drawing-board, bench and lathe. Aided even by the exercise of these qualifications, only they who possess natural aptitude and who labor long for success, can hope to achieve their object and become expert in their profession.



The examples given have been selected from many cases of actual practice, have all borne satisfactory results, and are therefore considered reliable.





They are given for the purpose of awakening thought and with the desire to encourage independent suggestion and inventive power; for this will be the surest pathway to a knowledge of the best methods of constructing patterns that will satisfy the varied requirements of the moulder.

In a shop employing a large number of workmen and doing a great variety of work, there will always be found those who excel in a particular kind of work. Some will be more expert in one class and others in another. In the giving out of work it is well to consider the efficiency of the workmen in this respect and, as far as possible, to make a judicious distribution.

When giving out a job the foreman should express to the workman his opinion as to how the pattern should be made and moulded, but he should also listen to and consider any suggestion made by the workman regarding it. Should the workman desire to make the pattern in a different way from that suggested by the foreman, and if a result equal in efficiency and economy can be thereby accomplished, he should be allowed to proceed in his own way, as he will then probably feel a greater interest in producing a good result.

Many good workmen consider it humiliating not to be allowed to use their own judgment as to the manner in which a piece of work should be done, and it is good policy not to altogether disregard their opinions unless they are manifestly at fault, but rather through an interchange of opinion arrive at a mutual understanding.

Men should be dealt with as men, and boys as boys, and not the reverse, which is sometimes attempted.

Loam moulding is resorted to when the article wanted is of too large dimensions or is too complicated in form to be moulded by any other method, or when the casting is not likely to be often duplicated. It is considered the most intricate, varied and expensive method of producing castings, whether of iron, brass or steel. On the other hand, the pattern work for loam moulding, while often very intricate, is of the most inexpensive kind.

Patterns for loam moulding are both of the simplest and the most complicated kind. The simplest are for bodies of revolution, or those objects which can be formed by revolving a radial section of the body about an axis. One of the simplest examples is the pattern work for a large plain kettle. These comprise a number of sweeps or strikes, in some places called strickles. A sweep consists of a plain piece of board whose profile is that exposed by a plane cutting the body parallel with, and passing through its axis.

The first sweep used in constructing a mould for a kettle is that marked A, Fig. 8. It is secured to the spindle, *a*, which is free to revolve about a vertical axis. The mould is built up of brickwork, with a thickness of loam intervening between it and the edge of the sweep, and, when the latter is revolved, it strikes or dresses the loam off to the form of the sweep. This part of the mould, when completed, is called the core, and forms the inside of the kettle.

The next sweep is used to form the thickness of the kettle. This is marked B, Fig. 9, and it supercedes sweep A on the spindle. Prepared moulding sand, *b*, is placed around the core and is swept to the outside form of the kettle by revolving the sweep. This concludes the function of the pattern work necessary for the job. The moulding is continued by building up brickwork, strengthened with plates, with a thickness of loam intervening between it and the moulding sand thickness.

When it is of great importance to insure a dense and solid bottom, the kettle is molded in the reverse position, bottom down. This is a somewhat more expensive method than the former. When molded the latter way, the sweeps are made the reverse of those described, and are used in the reverse order.

PATTERN WORK FOR A CYLINDER.

Large cylinders, with nozzles such as are used in beam engines, are objects well adapted to be moulded in loam. They require somewhat more pattern work than the former example. Fig. 10, represents a section of mould for a cylinder of this kind.

When preparing the pattern work for such a cylinder the first piece required by the moulder is the sweep A. This is used to form the seat or foundation of the mould. After the seat has been swept up and the sweep removed, the seat is lined off. The segment 12 is the next in order, and is made of board the thickness of the bottom flange of the cylinder, and having an inside radius equal to that of the outside of the flange. It is set as illustrated, and moulding sand is rammed inside of it to form the pattern of the lower flange of the cylinder.

The next piece in order used is the outside or cope sweep, 13. This being secured to the spindle, everything is prepared for the building of the outside of the mould. The patterns of the nozzles, 14, being prepared, they are set by lines in their proper positions during the building of the outside of the mould. The outside flange seen on the nozzle pattern is to form a seat for a covering plate. These plates have holes through them, through which the nozzle cores pass. The outside wall, or cope, of the mould being finished as far as the top of the upper flange and the sweep 13 removed, the cope is then removed from the seat, leaving the latter intact.

The main core sweep, 15, is next attached to the spindle, as illustrated. When the cylinder is a very long one, it is advisable to make this sweep in two pieces, batten them together and apply an additional spindle arm, *b*, above the batten. When the core has been built up above the joint in the sweep, the lower part of the sweep, as well as the extra spindle arm, can be removed and the buiding of the remainder of the core proceeded with. The core is extended about one foot above the top flange for the purpose of providing for a head to be cast on the top of the cylinder to receive the impurities of the metal and insure the solidity of the upper part of the casting. When the main core is completed, it is left standing on the seat and dried in that position.

The cope plate, *f*, is next prepared, and is usually a cast iron plate, one side of which is provided with prickers. This side is cov ered with loam and swept off with a straight sweep. When dry it is inverted and the mould extended on the upper side and made to form the outer wall of the head. The mould, when completed, presents an annular opening at the top, through which the metal is poured and drops to the bottom. Fig. 16 is the core box for the nozzle cores, and 10 represents a section of the mould when assembled.

A column of cast iron 3.84 inches in height and of one square inch in area, weighs one pound and exerts that pressure per square inch on its base when in a liquid state.

Assuming the foregoing cylinder to be 16 feet or 192 inches in height from the bottom to the head, the pressure will consequently be fifty pounds per square inch on the bottom of the mould. This great pressure has a straining effect on the mould—a tendency to separate its walls. If the walls of the mould are parallel with each other, that is, have a uniform distance between them from top to bottom, the casting would probably show a greater thickness of metal at the bottom. It is advisable, therefore, to set the sweeps to counteract this straining of the mould by the metal.

For a cylinder ten or twelve feet in height the core should be made one-eighth of an inch larger in diameter at the bottom than at the top, and the outer wall one-eighth of an inch smaller in diameter at the bottom than at the top. The mould would then measure one-eighth of an inch less between its walls at the bottom than at the top, but the thickness of the casting would most likely be uniform, owing to the straining effect of the metal on the mould while being filled. For a cylinder of 15 or 18 feet in height this difference between the walls of the mould at the top and the bottom can be increased to three-sixteenths of an inch.

The result of pressure on the liquid metal in a mould is to increase its density and strength when cold. In some instances moulds are arranged to receive a pressure in addition to that produced by the metal alone, as in the case of the Whitworth process of casting steel. Even should the mould not be strained to the extent allowed for, the casting will be strongest at the bottom, owing to the benefit resulting from the greater pressure there.

PATTERN WORK FOR AN ELBOW.

In constructing loam moulds it is not always necessary to have a spindle. Other bodies than bodies of revolution can be swept up in loam when the necessary guides are provided for the sweeps. Figs. 17 to 32 represent a large valve chamber combined with a nozzle or elbow, or bend. Fig. 17 is a frame made of ⅞ or 1¼-inch material. The interior of the frame corresponds with a horizontal section of the casting. The size of the opening at each end is extended in the frame for the same purpose that core-prints are made to form a seat, or support, as well as a guide for setting the core. The outside of the frame is worked off, to be parallel with the inside, for the purpose of forming a guide for the sweeps. Fig. 18 is the pattern for the flange at the valve chamber end; 19 that of the end of the bend; 20 is the pattern to form the bell shape where the diameters change. A pattern for this part is not absolutely necessary, as it can be formed by sweeps; but a pattern facilitates the moulding. Fig. 21 is the pattern for the branch, or nozzle; 22 is the sweep to form the outside of the mould at the bottom or drag part of the bend, and 23 that for the inside; 24 is the sweep to form the outside of the mould in the drag for the chamber and 25 that for the inside; 26 is the sweep for the core-print of the drag at the valve-chamber end, and 27 is the sweep for the core on the cope side of the bend; 28 is that for the outside of the bend; 29 is the sweep for the inside, or core, of the chamber on the cope side, and 30 that for the outside; 31 is the sweep for the core-print on the cope side. All of the necessary pattern work being prepared as described for the construction of the mould, its building can be proceeded with.

A foundation plate is first prepared, upon which the mould is to be built. The frame 17, with the lower or drag parts of the pattern screwed thereto, is set up on the plate, and brickwork of the usual kind for loam moulding is built up to the frame 17. While building up the mould the proper sweeps are used. The sweep 22 is used to form the outside of the mould by moving it around the bend with the semi-circular part projecting downward and the straight parts resting on the frame, while the projection on the end of the sweep is kept bearing against the edge of the frame. The sweep 24 is used in a similar manner to form the outside of the chamber. The sweep 23 is used like 22, to form the core seat at the end of the bend.

The mould for the outside of the casting being finished on the drag side, it is then dried, after which a thickness of green sand equal to that of the metal is worked around the inside of the mould, as shown by dotted lines, the sweeps 23 and 25 being used for the purpose in a similar manner to that of 22 and 24. The thickness being completed, the core is made on the inside up to the top side of the frame. The patterns for the upper or cope part of the flanges 18 and 19, also that for 20, are placed in their proper positions, and the building of the core is continued on the cope part of the mould, the sweeps 27 and 29 being used to reduce the core to its proper shape. After the core is completed, green sand equal in thickness to that of the metal is worked around the outside of the core, and the sweeps 28 and 30 used to reduce it to the form of the outside of the casting. The core-print on the cope side at the chamber end is formed by

the sweep 31. The branch or nozzle 21 is now set in its proper position on the pattern as formed. The core of the nozzle, which is made within the latter, is made to connect with the main core. The mould is then completed by the building up the cope half. The nozzle is made to be withdrawn from without,

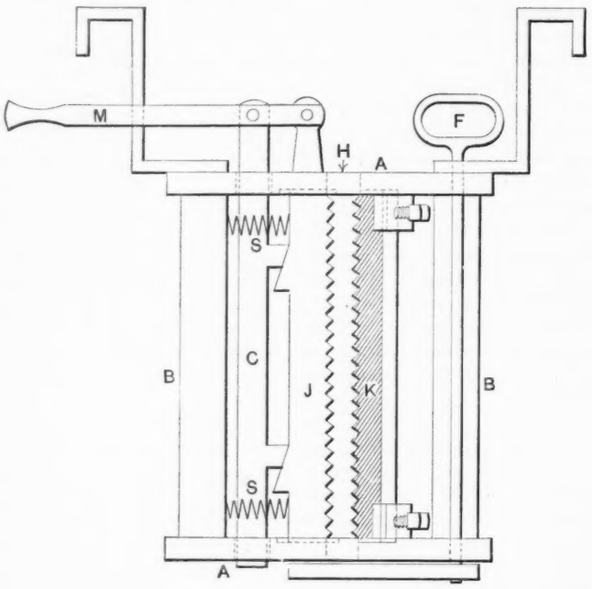


FIG. 1. SEE PAGE 9.

and a loam plate is made to cover the flange of the nozzle. When the mould is dissembled, the impression made by the frame 17 is filled in.

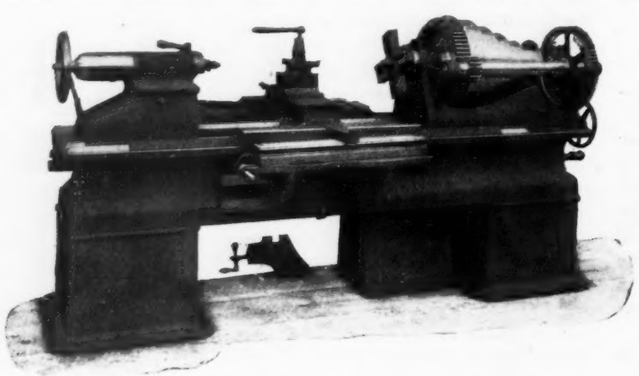
Nozzles are made to set at various angles on the chamber. In some cases more than one is cast on it. It will sometimes be advisable to make the nozzle pattern solid, with core-print attached, and have a separate core for it.

Fig. 32 illustrates the mould in part section when its building up is completed.

* * *

A 24-INCH GAUGE LATHE.

This lathe is built by the Fitchburg Machine Co., Fitchburg, Mass., for turning irregular shapes, such as moulds for glass manufacturers, handles, or other irregular, circular shapes.



FITCHBURG GAUGE LATHE.

The lathe is essentially the standard Fitchburg lathe, with the Chapman feed, which gives a quick change from the gear feed suitable for roughing to a coarser belt feed for finishing. The lathe can be used for ordinary work or for turning tapers in the usual way. A micrometer screw is provided for adjusting the rail to the taper attachment, which reads to thousands and acts at right angles with the axis of the lathe.

The gauge feature consists of a special arrangement in the carriage and on the taper attachment slide. To turn irregular pieces a former or gauge of the desired shape is fastened to the slide and a triangular pointer attached to the cross slide bears against it, as shown in the illustration, and is kept in contact with it by a spring under the cross-slide, thereby moving the tool to conform with the gauge.

The handle, which is just visible at the front of the carriage and on the side toward the tail-stock, is used for pushing the block back and keeping the pointer away from the gauge when running the carriage back.

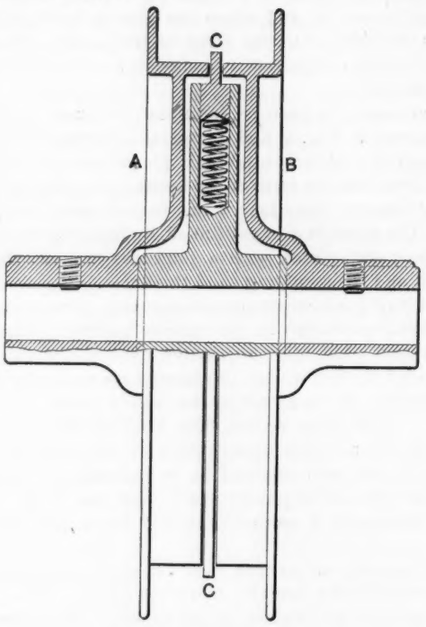
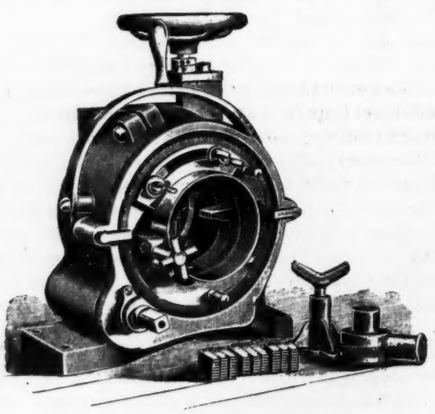


FIG. 3. SEE PAGE 10.

FORBES' IMPROVED PATENT DIE STOCKS.

The Forbes patent die stock, manufactured by Curtis & Curtis, of Bridgeport, Conn., has recently been improved in several respects. As the machine is well known to pipe-fitters, a general description will not be necessary.

Formerly the pressure feed pressed on the die carrying gear in only one place. This worked well as long as the machine was new and the gear a close fit in the shell. But experience taught that after the gear had become worn, the pressure of the feed coming in only one place on its surface, would tend to tip the gear slightly, which would prevent the dies from tracking and thus produce a "drunken" thread. With the double pressure system, shown in cut, the pressure is applied at two points on the face of the gear opposite each other, which prevents the gear from tip-



FORBES' DIE STOCK.

ping, no matter how strong the pressure or how large the gear may be in the shell. Another important change is the adjustable shell. The great trouble with all machines made with a die carrying gear surrounded and supported by a casing, is that sooner or later the gear will wear itself loose. Heretofore, when this occurred, it was necessary to supply either a new shell or a new gear, either of which was expensive. On all sizes of their machines they now put an adjusting screw on the shells shown in the cut, with which any wear can be taken up and the gear always kept a good working fit in the shell. This adjustment can be applied to old machines, making it possible to repair them at much less expense than formerly. These improvements are patented.

A MODERN AMERICAN SHOP.

DESCRIPTION OF SOME OF THE MACHINES AND OPERATIONS SEEN DURING A RECENT VISIT.

The Mossberg & Granville Manufacturing Company is one of the newer firms of the country, having begun business in 1889 at Attleboro, Mass., under the name of the Mossberg Manufacturing Company. At that time twist drills, grinders and jewellers' tools were made in a small way. At the present time new and

FIG. 2. PLAIN DROP PRESS.

extensive quarters are occupied in the new manufacturers' building at Providence, R. I. This makes an attractive and convenient housing, and gives an air of modernness which seems to be borne out by the equipment and the methods in vogue.

The output at present includes rolling mills, wire drawing machinery, drop, power and broaching presses, and a line of regular and special machinery of a similar character. One department of the works is given up to the manufacture of roller bearings, with which the readers of this are probably familiar, as illustrations of these bearings have been published.

FEATURES OF MANAGEMENT.

A pleasant feature of the system of management of these works appears to be the opportunities which are offered for a mutual interchange of ideas between the heads of different departments. The foremen meet once a month for a general discussion of affairs pertaining to the management of the work and the problems which arise. Evening lectures are given occasionally before the employees upon the use of the different machines built by the company, with the idea that when a workman understands fully the uses to which a machine is to be put, he will be better able to judge as to what the quality of his work should be.

Arrangements are also being made for an apprentices' society, with weekly meetings and lectures of an educational nature.

ROLLER BEARINGS AND HARDENING THE ROLLS FOR THE SAME.

Unquestionably the one thing that would most attract the attention of a mechanic here is the extensive and varied use to which the company's roller bearings are put. While nearly every one is aware of the great saving in friction that the use of such bearings will effect, it is not always realized how effectual and and durable they are under continuous, heavy service, when properly proportioned for such work. They are successfully used by this company, however, on their rolling mills, even the largest sizes. In another column of this issue, and in connection with some roller bearing data obtained from another source, will be found a table of suitable pressures, materials and speeds for roller bearings that was kindly furnished me by Mr. Lindgren, the head draughtsman.

Some interesting experiments with one of these bearings were recently made by the Hotchkiss Ordinance Company, on a Howell torpedo. This torpedo is propelled by the energy stored in a heavy balance wheel, which is speeded up to about 10 000 revolutions per minute, by means of a steam turbine. In this case the balance wheel weighed 300 pounds, and its shaft was $\frac{5}{8}$ inch in diameter. After running the wheel up to speed long enough for the bearings to be in good working condition, it ran one hour and thirty-five minutes after disconnecting the turbine.

All rolls for the better class of the Mossberg & Granville bearings are hardened and ground, the grinding being done on centers in a Brown & Sharpe universal grinder. In common with other people who have hardened work to grind, they were troubled a great deal by the rolls springing during the hardening process. In fact the rolls are so long and so small in diameter—some, for example, being 15 inches long and only $\frac{1}{4}$ of an inch in diameter—that in many cases it seemed to be impossible to make them come true enough to grind out by the ordinary method of hardening, regardless of the amount of care used. The method that was finally adopted was to heat the rolls uniformly in a gas furnace and then clamp them firmly their whole length, so they could not change when plunged into the water. This method was suggested by Mr. R. Forsell, and has met with perfect success. Those that I talked with who had had experience with the method believed that it could be used in hardening long reamers, taps, arbors, etc. Whether it might not lead to cracking in some cases, however, is a question.

A general idea of the clamp used can be had from the sketch in Fig. 1. The top and bottom plates A, A, and the connecting pieces B, B, constitute the frame. There are three clamping jaws spaced equal distances apart, two of which appear in the cut and are marked J and K. The roll to be hardened is dropped through

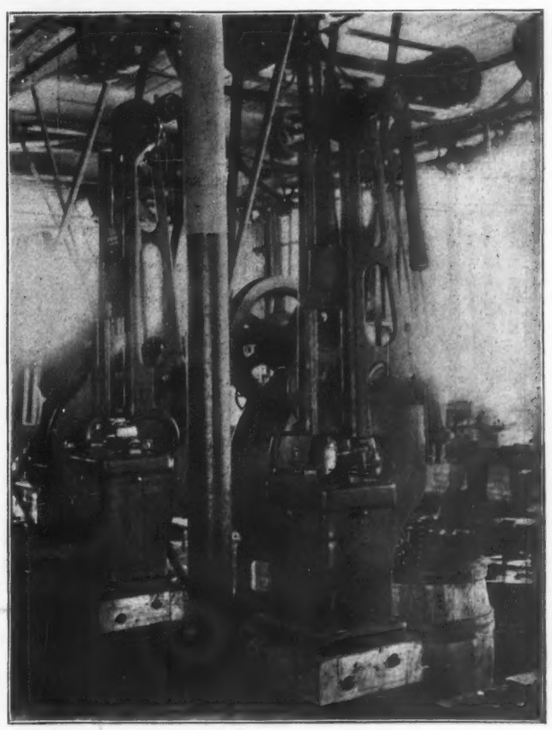


FIG. 4. AUTOMATIC DROP PRESSES.

the hole H and falls between the jaws; then, by pushing down on handle M, the cam piece C moves down and pushes the left-hand jaw to the right, thus clamping the roll. When the handle M is raised, jaw J opens under the influence of the springs S, S, and by turning the handle F, which moves the slide covering the hole shown at the bottom, the roll will drop out. The other two jaws, one of which is marked K, are adjusted out or in for different size rolls by set screws as indicated. The whole apparatus is made to suspend in a tank of water.

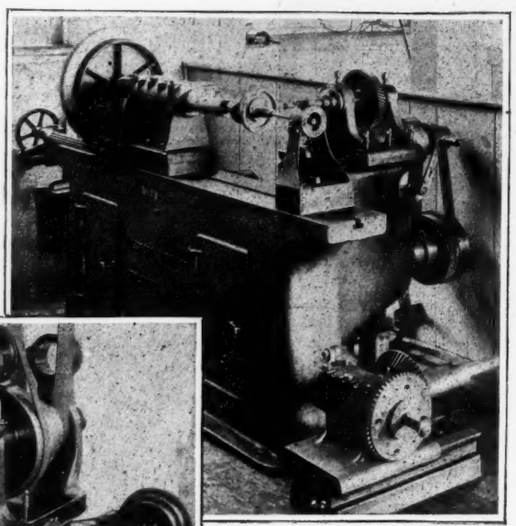
TYPES OF DROP PRESSES.

Other interesting features of the work here are the two styles of drop presses which are made and which can be seen in operation, thus affording an opportunity for comparing the two types.

In Fig. 2 is shown a plain drop, with the operator. This is the simplest form of press, and as all may not be acquainted with the method of operation of even this simple form, a few words of explanation may not be out of place. The hammer is raised by a belt which passes over a pulley revolving in a direction tending to lift the hammer. One end of the belt is attached to the hammer and, when the workman pulls down on the other end, sufficient friction is created between the revolving pulley and the belt to raise the hammer. When the workman releases his hold, the belt lies loosely over the pulley and the hammer falls. When the blow is struck, however, there must of necessity be more or less friction tending to lessen its force, since the pulley is revolving in a direction opposite to that in which the belt is then moving. To overcome this objection, a very simple and interesting device has been adopted, which, however, is patented. It is shown in Fig. 3, page 8. The pulley over which the belt passes is made in two parts, A and B, which are fastened to the shaft and separated a short distance from one another, thus forming an annular opening around the central part of the pulley face. An iron ring cut into segments projects through this opening and is forced out by springs, as shown. The ring, springs, and central spider which hold them are free to turn on the shaft independent of the pulley. It is clear, therefore, that when the operator pulls on the belt which passes over the pulley, the segments will be depressed and the friction between the belt and pulley will raise the hammer; when the tension in the belt is released, however, the springs will force out the segments, raise the belt from the pulley and relieve the friction.

One advantage of this style of press is evidently the absolute control of the operator over the force of the blow.

In Fig. 4 is a view of two of the automatic drop presses made by this company, and which are quite different from the ordinary board drops. Without attempting a detailed description, it can be stated that the hammer is raised through



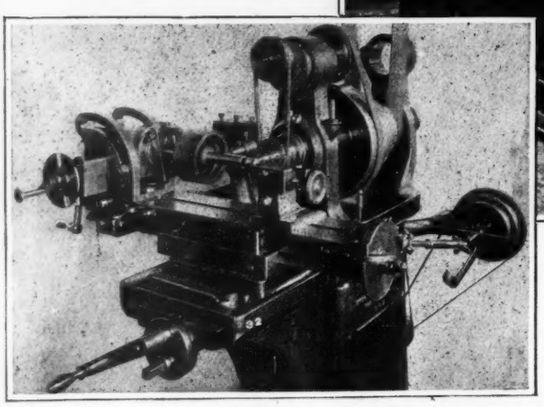


FIG. 6. DEVELOPMENT OF A CAM CUTTING MACHINE.

the crank motion and the two belts which are shown. The driving pulley, (on the further side of the machines on the cut), runs continuously. When started, it raises the hammer to a height depending upon the throw to which the crank just mentioned is adjusted. When the extreme upward point is reached, a clutch connecting the driving pulley with the crank is automatically thrown out and the hammer remains suspended, until it is released; and it is a point worthy of note that both hands of the workman are required to effect the release, thus reducing the chance of accident.

The advantage of this type, aside from its rapidity, appears to be the uniformity of the blow, thus enabling work to be done that is sometimes put on a punching or stamping press.

Figs. 2 and 4 also illustrate two types of foundations. The first is a spring foundation which is said to work well on the upper floors of buildings, or wherever it is not convenient to run through to the ground, and the second the ordinary column foundation. Unfortunately the engraving does not show up the spring foundation clearly. It consists simply of two parallel timbers raised from the floor by supports at their end and carrying the press midway between the supports.

A SPIRAL PLANING DEVICE.

Among the excellent photographs taken by the shop photographer, whose scrap-book I have drawn on for most of the illustrations accompanying these notes, is one of a spiral planing device, which is reproduced in Fig. 5. The engraving speaks

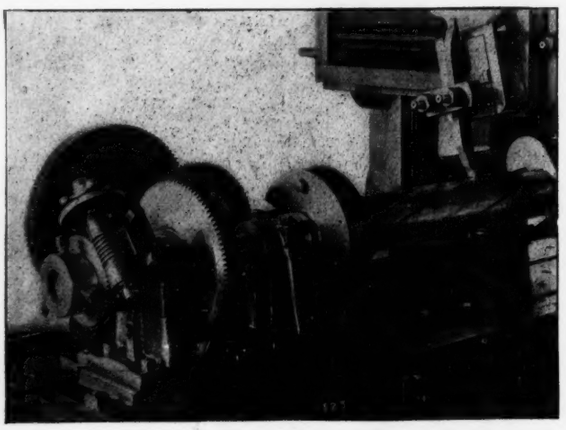


FIG. 5. A SPIRAL PLANING DEVICE.

for itself and needs but little explanation. As is usual with such devices, the necessary rotary motion is given to the piece being planed through two bevel gears, and a spur gear running in a stationary rack. The angle of the spiral is determined by the size of the spur gear which is used, the rack being raised or lowered as required, in order to bring it in mesh with the gear. Arranged in this way and with the bevels as shown, a right-hand spiral would be cut, and in order to plane a left-hand spiral provision is made for the insertion of an intermediate pinion between the gear and the rack, which gives a reversal of the motion.

A neat adjusting arrangement is used for bringing the work in exactly the right relation to the tool, and if desired, for feeding, through the medium of a worm and worm-wheel. The latter is fastened to the spindle carrying the work, and the former to a sleeve, which is simply a continuation of the hub of the bevel gear which is on the main spindle.

THE DEVELOPMENT OF A CAM-CUTTING MACHINE.

A not uncommon arrangement for milling cam profiles is shown in the lower part of Fig. 6. It is interesting, partly because it illustrates how easily a milling machine may be rigged to do work of this sort, and partly because the machine shown in the upper part of the illustration, which was designed especially for milling cams, is the outgrowth of this device. The original fixture consisted simply of a special arbor on which was the former, or master cam, and the blank to be shaped. The arbor was placed on the index centers and could be rotated by turning the indexing handle on the head. The forming cam bore against a roll running on a pin attached to the frame of the machine and the cam was kept in contact with it, either by means of a weight or by the handle actuating the traverse feed.

The new machine differs from this arrangement in principle chiefly in that the spindle carrying the cam has both a rotary motion, which is driven by power, and a sliding motion, which takes the place of a sliding head or table. A right-angle attachment is also provided, for milling plate cams.

L. G. F.

MECHANICAL DRAFT.—2.

WALTER B. SNOW.

It is somewhat difficult to distinguish between the effect of the fuel and that of the design of the boiler and its appurtenances upon the ultimate efficiency. To a considerable extent they are independent. Thus the introduction of mechanical draft as a boiler appurtenance makes possible the burning of certain grades of fuel and perfects the combustion of all grades. Properly speaking, the fuel itself is made more efficient, but this result is secured only by a feature of the boiler plant.

So far as possible, the influences directly affecting the fuel will be here first considered. Roughly speaking, the value of a fuel is inversely proportioned to the amount of ash it contains. But beyond its indication of the relative presence of incombustible matter, the influence of ash upon the thermal efficiency of coal is three-fold. Its presence is the measure of the loss through the amount of unconsumed carbon which it contains, through the heat lost when the ash is removed in a heated condition and through the influence of the ash in clogging the fire. With the ash there is also always present, particularly with small coals, an amount of fine pieces or dust.

Moisture in the coal demands a wasteful expenditure of heat, for not only must this moisture be heated, but also evaporated into steam and raised to the temperature of the escaping gases.

The size of the coal is of much more importance than is usually considered. As a rule the finer the coal the less efficient and the greater the necessity of intense draft. Upon the burning of the small anthracite coals is dependent much of the economy which can be secured in steam production. Foremost among the requisites for burning such fuel is mechanical draft. The actual results obtained will be discussed later, but it may be here stated, as showing the relative merits of different sizes of small anthracites, that the late Eckley B. Coxe obtained, in connection with a return tubular boiler equipped with a Coxe stoker and travelling grate, the results presented in Table No. 5.

In this form of traveling grate separate compartments are provided beneath, into each of which air is forced by means of a blower, and within each of which the pressure is graduated according to the stage of the combustion.

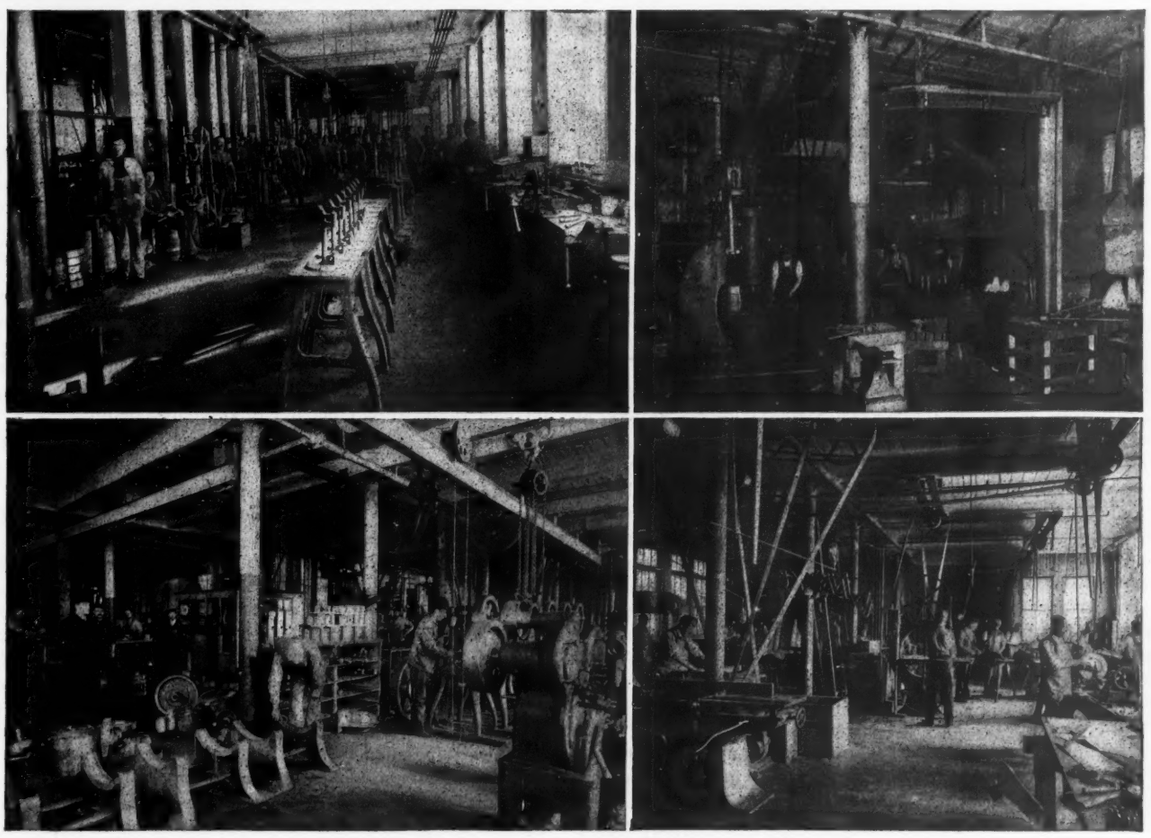
TABLE NO. 5.—RELATIVE EFFICIENCIES OF SMALL ANTHRACITES.

KIND OF COAL.	Pounds of Water per pound of Coal, from and at 212°.	Pounds of Water per pound of Combustible, from and at 212°.
Buckwheat	8.77	11.07
Rice (No. 2 Buckwheat)	9.05	11.18
Culm (Pea, Buckwheat, Rice, Barley, Dust)	8.74	11.19
Barley (No. 3 Buckwheat)	8.39	10.89

The influence of the air supply noticeably stands out as one of the most important factors in its effect upon the combustion, although the loss which occurs through an improper amount of air supplied, it is not properly chargeable to the fuel, but rather to the means by which the air movement is produced. Evidently the more flexible and controllable the means, the more properly proportioned will be the air supply. The method of calculating the theoretical amount of air required for the combustion of any fuel has already been explained. If less than this amount is supplied, or if it be improperly distributed, a portion of the carbon passes off unconsumed and forms smoke, while part of the remainder, being insufficiently supplied or brought into contact with oxygen, forms carbonic oxide.

If the air be supplied in excess of the actual requirements, the loss is two-fold. First, the excess of air entering the furnace is heated by the burning fuel, thereby lowering the temperature of the mixture of gases and air, and reducing the rate of absorption of heat by the water. Second, owing to the larger volume and higher velocity, the temperature of the escaping gases is higher than it would be were there no excess of air. Hence the possible economy resulting from the admission of air in just the proper amount under the most desirable pressure as is rendered possible where mechanical draft is employed. The losses in efficiency which may occur on account of admitting an excess of air or of allowing the gases to escape at too high a temperature, are presented for various conditions in Table No. 6.

This table relates to the combustion of one pound of coal. An air supply 100 per cent. in excess of that chemically required, and a temperature of escaping gases of 450° above the atmosphere, represents fairly well the ordinary conditions with chimney draft in a carefully operated plant, under which it will be noted that the loss is no less than 17 per cent. So long as the



SOME VIEWS FROM THE MOSSBERG & GRANVILLE SHOPS—SEE PAGE 9.

volume and temperature remain constant this loss is unavoidable. A chimney requires a high and wasteful temperature of gases to produce the draft, but this is unnecessary with mechanical means for draft production. A moderate reduction to 75 per cent. excess air supply and to 300° temperature of escaping gases, would show an economic gain of 7 per cent.

TABLE NO. 6.—LOSS OF EFFICIENCY DUE TO EXCESS OF AIR, AND TEMPERATURE OF ESCAPING GASES ABOVE ATMOSPHERE.

Excess of Air in per cent. of that chemically required.	Temperature of Escaping Gases above Atmosphere.											
	300°		350°		400°		450°		500°		550°	
	Total B. T. U. in Gases.	Loss in per cent. of Total Heat Value of Coal.	Total B. T. U. in Gases.	Loss in per cent. of Total Heat Value of Coal.	Total B. T. U. in Gases.	Loss in per cent. of Total Heat Value of Coal.	Total B. T. U. in Gases.	Loss in per cent. of Total Heat Value of Coal.	Total B. T. U. in Gases.	Loss in per cent. of Total Heat Value of Coal.	Total B. T. U. in Gases.	Loss in per cent. of Total Heat Value of Coal.
0	695	5.9	812	6.9	928	7.9	1044	8.9	1160	9.9	1276	10.9
50	1016	8.7	1185	10.1	1354	11.5	1524	13 0	1693	14.4	1862	15.9
75	1176	10.0	1372	11.7	1568	13.3	1764	15.0	1959	16.7	2155	18.4
100	1336	11.4	1558	13.3	1781	15.2	2003	17.0	2226	19.0	2448	20.9
125	1495	12.7	1745	14.9	1994	17.0	2243	19.1	2492	21.2	2742	23.4
150	1655	14.1	1931	16.5	2207	18.8	2483	21.1	2759	23.5	3035	25.9
175	1815	15.5	2118	18.0	2420	20.6	2715	23.1	3025	25.8	3328	28.4
200	1975	16.8	2304	19.6	2633	22.4	2957	25.2	3291	28.0	3621	30.8

The efficiency of any given fuel must ultimately be judged by the cost of producing a given amount of steam. Commercially considered, such efficiency not only concerns the amount of water evaporated by a pound of fuel, but in so far as the use of a given fuel depends upon the arrangements provided therefor, it is directly dependent upon the following items of expense: *First*, interest, rent, taxes and insurance on the cost and the depreciation of the plant; *second*, repairs; *third*, cost of water from which the steam is generated; *fourth*, labor; *fifth*, getting rid of the ashes; *sixth*, cost of the fuel in the boiler house.

The largest and most important of these factors is the cost of the fuel itself, which should be measured not by the number of pounds, but by the available heat units obtained for a given price. It is not to be expected that a cheaper fuel will evaporate more water per unit of weight, but it is possible by employing proper means, such as mechanical draft, to burn a coal of inferior quality and yet secure a greater evaporation per unit of cost.

Based upon the cost of the coal and firing, the following will serve to illustrate the economy which may be thus secured.

In a certain plant equipped with horizontal tubular boilers and down-draft furnaces, an evaporation of 8.5 pounds of water from and at 212° was regularly obtained. The coal used was Illinois slack, costing $1.40 delivered under the boilers. This makes the cost about 8.3 cents per 1 000 pounds evaporated under these conditions. Had the best picked anthracite coal, costing $4.80 per ton under existing market rates, been used, and had it evaporated the generous amount of 12 pounds of water from and at 212°, the cost would have been 20 cents per 1 000 pounds.

Intense draft is recognized as one of the most important factors in the utilization of cheap fuels, hence the value of mechanical draft. An instance of the increased economy resulting from its application is that of the United States Cotton company's Mills at Central Falls, R. I. The boiler plant consists of three Babcock & Wilcox boilers, having a total rating of 1 005 horse power. The draft is furnished by a Sturtevant blower, which forces the air into the ash-pits, and whose speed is automatically regulated by a special device, so that the volume of air and intensity of draft are continually changing to suit the varied conditions and requirements of the fire. Before this mechanical draft plant was put into operation, the fuel employed was George's Creek Cumberland coal, costing $4.00 per ton delivered at the boiler room. Since the fan with automatic control has been in use, the quality and price has been reduced to a mixture of about 70 to 75 per cent. of No. 2 buckwheat, 20 to 25 per cent. of yard screenings, and 5 to 10 per cent. of Cumberland, costing $2.62 per ton. This change has reduced the fuel cost per indicated horse-power on the engine by $0.001235 per horse-power per hour. At the horse-power developed by the engines, the present saving per week is over $126.00, when all fuel, including that for banking fires, is taken into account.

Prominent among, if not most important of, the factors in the prevention of smoke is mechanical draft. As smoke is a result of incomplete combustion, its prevention must be sought through the provision of an ample supply of air, with sufficient intensity of draft and the maintenance of a high temperature of the fuel bed. Unless the proposed preventative device meets these requirements it has little hope of success. As the amount of unconsumed carbon in smoke seldom if ever exceeds 1 per cent. of its total weight, the economic aspect of smoke prevention concerns the steam maker or user only in so far as it avoids a nuisance which, under stringent laws, might absolutely prevent the operation of the boiler plant.

Although the common practice is, and has long been, to express the efficiency of a boiler by the number of pounds of water evaporated per pound of coal or combustible, yet this fails to give absolutely comparable results. The ideal basis of comparison is to be sought in the ratio found by test to exist between the total effective heat of the coal and that rendered evident in the steam generated, which may be thus expressed:

$$\text{Efficiency} = \frac{\text{Heat units usefully applied.}}{\text{Heat units supplied to furnace.}}$$

As the result of such a determination, a heat balance can be presented which will embrace the following items:

Dr.	Cr.
To heat	By heat
From coal	in dry steam.
From air	in moisture and water mechanically suspended in steam.
	in dry flue gases.
From feed-water	in moisture in coal.
	in water resulting from combustion. } of temperature of flue gases.
	in vapor in air. } of temperature of flue gases.
	lost through incomplete combustion to CO.
	in ashes.
	lost by radiation and otherwise unaccounted for.

Evidently a point must be reached considerably short of 100 per cent. beyond which the loss in interest, depreciation and other fixed charges will exceed the gain from the decreased cost of fuel per unit of evaporation resulting from the given improvement. In this light must be considered any attempt to greatly increase the existing efficiency of any boiler plant.

As is well known, the usual commercial rating of a steam boiler is measured by its horse power, as arbitrarily established at 30 pounds of water evaporated from a temperature of 100° into steam of 70 pounds. This is equivalent to 34.5 pounds evaporated from and at 212°.

The possibilities of increased efficiency of steam boilers can best be studied in the light of the means by which the heat of the fuel is distributed and by a consideration of the losses which are bound to occur in any ordinary boiler plant. The heat which is generated by the combustion has presented two methods by which it may be transmitted to the water within the boiler. First by radiation, and second by convection. By both these means the heat is so rapidly communicated to the water that it becomes impossible to maintain in the furnace, a temperature near the maximum ideal temperature of combustion. But all of this heat is not finally absorbed by the water. As it is the primary function of a boiler to utilize as much as possible of the heat generated by the combustion of the fuel in the furnace provided for the purpose, it is to be expected that the gases will be gradually cooled as they approach the chimney. The greater the decrease, and other things equal, the lower the final temperature, the higher the efficiency. But with a chimney it is necessary that the escaping gases have considerable temperature in order to produce the requisite draft. As a consequence the loss of heat by means of the temperature of the flue gases is always of considerable importance. Table No. 7 serves to show not only this, but the various other losses which were found to occur in a number of exhaustive tests upon boilers differing widely in their design. All figures are given in percentages of the total amount of heat accounted for.

Some of the sources of efficiency have already been discussed under the efficiency of fuel. In fact the efficiency of a fuel and of the boiler in connection with which it is burned are so interdependent that it becomes difficult to separate them in any consideration. There are, however, certain factors in the matter of boiler efficiency which may be taken up independently. First among them is the feed-water heater or economizer. The economy resulting from the introduction of such a device, when the draft is sufficient, naturally depends upon the normal temperature of the flue gases escaping from the boilers and of the feed-water when it enters the economizer. With feed entering at 50°

and leaving at 200°, a gain of nearly 13 per cent. may, for instance, be shown by this method of utilizing the waste heat.

A device similar in its object, but somewhat different in its application, is the air heater or abstractor. A common type consists of a series of tubes through which the furnace gases are

TABLE NO. 7.—DISPOSITION OF HEAT IN STEAM BOILERS.

Disposition of Heat.	Authority.						
	Bunte.	Scheurer and Meunier.		Donkin and Kennedy.			Hoadley.
	A	B	C	D	E	F	G
Waste in flue gases, including moisture in coal and heating vapor in air when these losses are not separately given	18.6	5.5	14.8	9.4	22.5	6.5	5.04
Evaporating moisture in coal	3.5	2.5	6.1	0.1	0.1	0.0	1.55
Heating vapor in air							0.18
Imperfect combustion	8.0	6.0		12.7	0.0	0.0	
Clinker and ash	4.1			0.1	0.2	0.0	
Radiation and heat not otherwise accounted for	7.6	23.5	13.4	13.9	11.0	15.0	4.0
Heating and evaporation of water	58.2	61.0	65.7	63.8	66.2	78.5	87.80

caused to pass after leaving the boiler, and around which the air supply circulates before entering the ash-pit. Such a device will be largely dependent for its success upon the intensity of the draft, which, as a rule, can only be economically secured by mechanical means. A series of most exhaustive experiments conducted by the late J. C. Hoadley upon a boiler fitted with a heat abstractor of this character, showed results which are presented in Table No. 8. The boiler fitted with the abstractor is known as the warm-blast boiler, while the regular boiler was of the same type, standing adjacent, but without the abstractor. They were both fired by the same man and with fuel from the same pile. A blower was used in connection with the warm-blast boiler in order to produce the requisite draft.

TABLE NO. 8.—RESULTS OF COMPARATIVE TESTS WITH WARM-BLAST AND REGULAR BOILERS.

Location at which Temperature was taken	Temperatures.		
	Regular Boiler.	Warm Blast Boiler.	Difference.
In heart of fire	2493°	2793°	300°
At bridge wall	1340	1600	260
At pier	895	1050	155
In smoke-box	373	375	2
Air admitted to furnace	32	332	300
Steam and water in boilers	300	300	0
Gases escaping to chimney	373	162	211
External air	32	32	0
Gases cooled, Warm-Blast Boiler			213
Air warmed, " " "			300

The abstractor on the warm-blast boiler was subsequently altered, the first form being thereafter designated as warm-blast boiler No. 1, and the new arrangement as warm-blast boiler No. 2. The economic results with anthracite and bituminous coals are presented in Table No. 9.

TABLE NO. 9.—RESULTS OF COMPARATIVE ECONOMIC TESTS WITH WARM-BLAST AND REGULAR BOILERS.

	With Anthracite Coal			With Bituminous Coal.	
	Regular Boiler	Warm-Blast Boiler No. 1.	Warm-Blast Boiler No. 2.	Regular Boiler.	Warm-Blast Boiler No. 1.
Temperature of escaping gases	368.3°	189.°	164.°	376.9°	196.°
Gases cooled by abstractors	0	207.9	213.	0	201.4
Air warmed by abstractors	0	303.7	285.	0	315.5
Loss at chimney, per cent	17.75	15.00	12.83	17.03	14.24
Loss by radiation from brickwork, per cent	2.64	4.00	4.00	3.39	4.00
Loss by imperfect combustion, per cent.	2.13	0.63	1.43	2.85	1.00
Efficiency reduced to common basis, per cent	68.87	78.18	81.43	64.61	77.59
Points gained by Warm-Blast Boiler		9.31	12.56		12.98

The Serve and similar tubes having an extended surface show a gain in efficiency more or less important according to circumstances, but require additional draft, which is usually furnished by mechanical means.

Intensity and uniformity of draft such as is secured by means of a fan have also much to do with the increased boiler efficiency when mechanical stokers are used therewith.

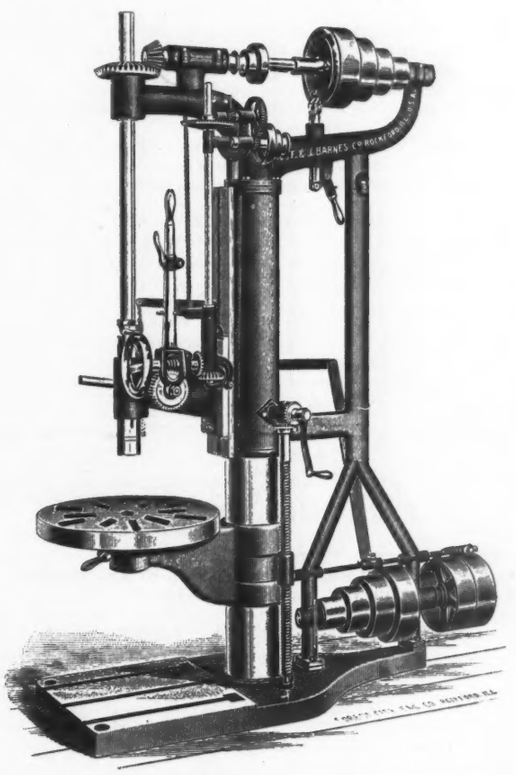
* * *

Thanks to the application of roller bearings, the big bell at St. Paul's, London, rang out with renewed vigor in honor of the Queen's Jubilee. The bell weighs 25 tons, and before roller bearings were used was a regular "man killer."

A NEW DRILL PRESS.

A 26-inch sliding head drill has recently been put on the market by the W. F. & John Barnes company, of 231 Ruby St., Rockford, Ill. which has some novel and interesting features.

In accordance with their usual practice in the construction of drill presses, a form of "differential" or "epicyclic" gearing is used in place of the regulation back gears. This gearing is of internal movement and is enclosed in the upper cone, away from dirt and dust, and we are informed is giving the best of satisfaction, both to the manufacturers and users of these drills. Mechanics who have had to run drill presses where the back gears are awkward to get at, and difficult to throw in after they have been reached, will appreciate the convenient position of the handle used for this purpose, as shown in the illustration.



The feature of the machine that is believed to be entirely new, however, is the application to a sliding head drill of all the feeds that can be applied to a drill with a stationary head. The operator has at his disposal a lever feed, hand worm feed, power feed, automatic stop and quick return. Because of its combined power and sensitiveness, the hand lever feed would be a valuable addition to almost any type of drill press, if it could be placed so as not to interfere in anyway with the operation of the machine and at the same time be convenient to use. Apparently the lever feed, as used on this drill, fulfills these conditions perfectly.

The main dimensions of this drill are as follows: Greatest distance from spindle to base, 53 in.; diameter of spindle, 1 $\frac{11}{16}$ in.; travel of sliding head, 21 in.; large and small diameters of cones, 10 and 4 in.; face of pulleys, 3 in.; ratio of bevel gears, 3.75 to 7.75; ratio of back gearing, 5½ to 1.

* * *

A FIFTY-CENT FIZZLE.

Locomotive Engineering is responsible for the following:

"The latest put-up-job collision of locomotives occurred at Jamestown, N. Y., in a way which wasn't altogether satisfactory to the twenty-five hundred would-be spectators who planked down their little fifty cents to see the show. A huge tent had been erected, and according to programme the victims of the conspiracy were to come together in the center of the tent. But the "best laid plans" failed to meet expectations, and one of these engines got her back up and didn't make schedule time. The onlookers had the satisfaction (?) of seeing one engine hump herself through the tent and heard the "dull and sickening thud" outside—but they didn't get a glimpse of the collision."

COPYRIGHT, 1897, BY THE INDUSTRIAL PRESS.

Entered at the Post-Office in New York City as Second-class Mail Matter.

MACHINERY,

A practical journal for Machinists and Engineers, and for all who are interested in Machinery.

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS,

411 AND 413 PEARL STREET, NEW YORK CITY.

ONE DOLLAR A YEAR, POSTAGE PREPAID, TEN CENTS A COPY.

FOREIGN SUBSCRIPTIONS ONE DOLLAR AND FIFTY CENTS A YEAR.

Lester G. French, Editor.

F. F. Hemenway, Consulting Engineer.

Walter Lee Cheney, S. Ashton Hand,

Associate Editors.

The receipt of a subscription is acknowledged by sending the current issue. Remittances should be made to THE INDUSTRIAL PRESS, and not to the Editors. Money enclosed in letters is at the risk of the sender. Changes of address must reach us by the 15th to take effect on the following month; give old address as well as new. Domestic trade is supplied by the American News Company or its branches.

We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 10th of the month preceding publication.

FOREIGN AGENCIES OF MACHINERY.

AFRICA.—Cape Town: Gordon & Gotch.—Johannesburg: Sherriff Swingley & Co.

AUSTRIA-HUNGARY.—Vienna: White, Child & Beney; F. A. Brockhaus; Lehman & Wentzel.—Budapest: Ormai & Co.; Jos. Schvarcz & Co.; Szekely & Kaldor.

AUSTRALIA.—Adelaide, Victoria: W. C. Rigby.—Brisbane, Queensland: Gordon & Gotch.—Melbourne, Victoria: Gordon & Gotch.—Sidney, N. S. W.: Turner & Henderson.—Townsville, Queensland: T. Willmett & Co.

BELGIUM.—Antwerp: L. Verstrepen-Eliaerts.—Brussels: Librairie Castaigne, Montague aux Herbes Potageres, 22.

CHINA.—Hai Phong, Tonkin, Indo-China: E. C. Chodzko.

DENMARK.—Copenhagen: V. Lowener.

EGYPT.—Alexandria: G. Artuso Molino.

ENGLAND.—Birmingham: Chas. Churchill & Co., Ltd.—London: Buck & Hickman, 285-291 Whitechapel Road; C. W. Burton, Griffiths & Co., 158 Queen Victoria street; Chas. Churchill & Co., 15 Leonard street; Chas. Neat & Co., 112 Queen Victoria street; W. H. Smith & Son, 186 Strand, W. E.—Manchester: Henry Kelley & Co., 96 Pall Mall.

FRANCE.—Paris: Boyveau & Chevillet, 22 Rue de la Banque; L. Roffo, 58 Boulevarde Richard Lenoir; Fenwick Freres & Co., 21 Rue Martel.

GERMANY.—Berlin: A. Usher & Co., 5 Unter den Linden; F. A. Brockhaus, 14 Oberwallstrasse, W.—Dusseldorf: M. Koyemann.—Mulhouse: H. Stuckelberger.

HAWAIIAN ISLANDS.—Honolulu: Hawaiian News Co.

HOLLAND.—Rotterdam: H. A. Kramer & Son.

INDIA. Bombay: Thacker & Co., Ltd. Calcutta: Thacker, Spink & Co.

JAPAN. Nagasaki: Lake & Co. Yokohama: Andrews & George.

JAVA. Tegal: W. J. Amons.

MEXICO. City of Mexico: F. P. Hoeck.

NEW ZEALAND. Aukland: J. Fiynn.

RUSSIA. Moscow: J. Block & Co.; G. Koeppen; Meliler & Co. St. Petersburg: Wosidlo & Co.; F. de Sazzeyanski; Carl Ricker.

SPAIN. Barcelona: Librairie A Verdaguer. Madrid: Librairie Guttenberg.

SWEDEN. Stockholm: E. Hirsch & Co.; B. A. Hjorth & Co.

SWITZERLAND. Zurich: Mayer & Zeller.

TURKEY. Constantinople: V. L. Levy.

THIS PAPER HAS THE LARGEST CIRCULATION OF ANY PUBLICATION IN THE MACHINERY TRADE.

SEPTEMBER, 1897.

CONTENTS:

Some Notes from an English Shop... 1
How to Develop our Machinery Trade Abroad... 4
Roller Bearing Data... 5
Practical Pattern Making (4)... 6
A Modern American Shop... 9
Mechanical Draft (2)... 11
An Example not to be Followed (Ed.) 14
Improvement in Machine Design" 14
German Workshops... 15
The Biggest Pump in the City... 16
Seen in Various Shops... 16
Brass Working Tools (3)... 18
A Simple Test of Engine Friction... 19
How to Calculate, Design and Construct Electrical Machinery (4)... 20
Economy in the Generation and Use of Steam... 22
Mechanism for Mechanics (7)... 22
Knots and Miles... 23
Rules and Formulas for Steam Engineering... 23
The Hartford Convention... 24
Is Prosperity Really Coming?... 25
Spur Gear Arithmetic (3)... 27
What Mechanics Think... 30
How and Why... 34

JOHN WEDDERBURN & CO., the Washington patent lawyers, have been notfied by the Commissioner of Patents to show cause why they should not be disbarred for their unprincipled methods. Nearly two years ago their advertisement was refused by MACHINERY, because we believed they were seeking to obtain money from hard-working mechanics in exchange for valueless patents; but it has been published up to a very recent date by all our contemporaries, although they must have known well the character of the business which they were aiding.

* * *

IT is rather pleasing to Americans to know that the order for the equipment with motive power of the London Central Railway comes to this country, especially when the reason for it is frankly admitted to be that the manufacture of electric transmission machinery is better understood here than in England, or elsewhere. It is nothing to be boastful of, but something to feel well over nevertheless. There is not much sentiment among Englishmen about buying machinery, or anything else as to that matter. An Englishman is, of all men, not given to buying something because it is made "at home." He buys it because it serves his purpose best to do so, in which he is probably about right. The London Central gave the order here—and it was a large one—from a consideration, in the long run, of dollars and cents, and for no other reason. There is not a bit of flattery in the transaction.

* * *

Another pleasing transaction was the giving of an order for 8 000 tons of steel rails to an American firm by the East Indian railway, a road owned by the government. It is not so very long since we were buying our steel rails from England; now the tide seems to be changing. It is not much wonder that there is some unpleasant comment in England over this matter. We can only imagine what would be said here if this government were to buy steel rails abroad. But English mills would not bid low enough, and that settled the matter.

However, it is not wise to be too much elated over this. Manufacturing is brisk in England and dull here, which makes a good deal of difference. It might be pertinent to ask, moreover, if our own roads could buy 8 000 tons of steel rails for the same amount of money that these were sold to the English Government? We suspect not.

* * *

AN EXAMPLE NOT TO BE FOLLOWED.

Anyone who has noticed the illustration of the friction shaper on the first page of this issue, and which accompanies the article by James Vose, has probably observed that the driving and reversing mechanism is an exact copy, to all outward appearances at least, of that used and originated by the Hendey Machine Company, in this country. The shaper is made by the Atlas Engineering Company, of Manchester, England, who, Mr. Vose remarks, "build tools on both English and American lines to suit the purchaser's requirements."

It is undoubtedly the case that tools combining American ideas of convenience and utility, with such English features of construction as are generally considered to be essential by Englishmen, may have selling points of advantage for trade abroad not possessed by tools which are distinctively of one type or the other. Recent American designs, intended for foreign trade, show that the Atlas company is not the only one appreciating this fact; but we trust that the firms seeking to bring about this combination of ideas by copying outright from others will be few and far between. So far as we know, foreign manufacturers have not suffered in this respect at the hands of American builders. While such methods may bring temporary gain, they must eventually re-act to a greater or less extent upon those practicing them.

In justice to Mr. Vose, who sent us the photograph, it should be said that he is probably not aware that the machine in question is so near akin to its American progenitor.

* * *

IMPROVEMENT IN MACHINE DESIGN.

When one sees one of the earlier electric motors or dynamos that was designed during the first few years of the present electrical era, he is struck with the great improvement that has taken place within a comparatively short time in the design of these machines, from a purely mechanical stand-point. It is the same story over again that has been witnessed in the construction of machine tools. The time was when there were no such persons as mechanical engineers or designers, or even pattern makers, and the designing, what little there was of it, was done by civil engineers and carpenters. They had no knowledge of the requirements or the possibilities of mechanical work, and the tools which they produced were exactly what might

have been expected. They were graceful in the eyes of the civil engineer and architectural beauties according to the carpenter's ideas.

So in electrical machinery. When this branch of engineering began to develop, hundreds of "electricians" and young college men, well posted, probably, in electrical science, rushed into the business. The machines designed by them doubtless represented the highest state of the art at that time, from an electrical stand-point, but, like the early machine tools, they showed very plainly that their designers had no appreciation of good mechanical construction. This is all the more marked, because the mechanical elements in these machines are of a simple nature.

There are a good many people who do not believe it; but it is a fact, nevertheless, that it requires training, experience and sound judgment, and just as much of it, to do satisfactory mechanical work as any other line of work. History shows this and we meet with examples every day that prove it.

* * *

[SPECIAL CORRESPONDENCE].

GERMAN WORKSHOPS.

When living in Paris some years ago, I met casually, through having to act as interpreter for her in some altercation with a railway employee, an American lady who, after expressing her joy at finding some one who could speak the language of God's country, confided to me that she was a "journalist" (a term which I understood to mean an amateur writer for the press, as distinguished from a "newspaper man" or woman) and was writing about the home life of the French. To my query where she was living, she replied, "In a boarding-house." She knew no French families, she could not speak French, and yet she was going to "do up" a topic which should be approached only after enjoying exceptional opportunities.

The application of this story is against myself; for despite rather better opportunities than most have for seeing the interior of German machine shops, I must state in advance that Germans do not show their shops even to each other, as we do in America. If their shops are not so good as the average, they do not hasten to parade their inferiority; if they have better facilities than their rivals, they do not take pains to make their nature public property. The German is above all commercial. He seldom lets his pride interfere with his order-book. In this he is right.

This property does not prevent his visiting our shops and flattering our manufacturers, so as to get "pointers" for home consumption. In those shops where (principally because I am getting work done in them, or may get things made) I have been granted the *entree*, I find American "wrinkles" and American tools—the wrinkles usually disguised and seldom credited, and the machine tools with the maker's name chipped off or the name-plate removed. I may put this down as a feature of German shops, particularly of tool-builders' shops. A moral may be extracted from it, without dynamite and grappling irons.

Perhaps the first remark that I may make about German shops is the amount of ground that they have at their disposal—even in thickly-settled Saxony. I would venture to say that the Baldwin Locomotive Works turn out more locomotives per year per acre of ground and per thousand square feet of shop floor, than any locomotive works in Europe; perhaps by three to one. There seems to be no end of room, not merely for machines and for assembly, but for storage—to say nothing of flower-beds and an occasional fountain or so, in front of many of the larger works.

A second thing that strikes me is the solid character of the buildings, stone being used so largely in construction, and the general get-up being of a kind to permit heavy work to be put on a planer in a second story without putting all the shafting on the first floor out of line (I speak in the Philadelphia sense, where the first floor is the first one counting from the ground).

A third point is one which used to strike me as very comical and undesirable, a number of years ago, but which now impresses me very favorably—the proximity of the proprietor's house to the shops. A very frequent type of grounds is one which has the shop front on the street or road, with wagon entrance on one side to the shops and yard, and carriage entrance on the other, with carriage-drive leading to the private grounds at the back, where one finds a conservatory, fine lawn, fountains playing, arbors offering cool retreat, and all that sort of thing, right in the shadow of the shop chimney, but as surroundings to the villa. The private stables are probably in connection with the shop stable; a telephone connects the house with every department of the shop, and the house is probably lighted from the shop dynamo. This type one is more apt to find in small towns like Merseburg.

A common style in Dresden is just "the other way to;" for instance, the villa will be on the street line, with its pretty front garden, its "Laube" or coffee arbor in the corner, overlooking the pavement, and entrance to the shop at the back of the grounds, through a handsome wrought-iron portal. The shop will be a plain, rough-cast or brick building, clear back at the rear of the lot.

A third type or arrangement in cities, especially in Dresden, is the shop in the court. The "blocks" in such cities are very large, the cross-streets few, and the buildings stand shoulder to shoulder on the street line, with archways at convenient distances, leading under the second story of the house to the court at the back. In this court one finds one or more shops, the chimneys reaching up and overtopping the house from the back.

A fourth type is where the proprietor or the foreman lives over the shop. (I am not speaking now of small firms, but of establishments having a national and even an international reputation and trade.) I have in mind a file factory in Radeberg, where the offices are on the ground floor of the front building and the dwelling in a flat on the floor above, the shop proper being a one-story extension in unbroken connection with the office floor. A second is in Meissen, where, in an immense and constantly growing mass of buildings, the member of the firm who has charge of the manufacturing, as distinguished from the commercial end of the business, lives in a convenient flat at one end, of the street, and the "procurist," or responsible man with power of attorney, in one at the other end; each having separate street entrances. The senior member of the firm lives a couple of blocks away, but that is probably for family reasons, to be in the same building with aged relatives who are physically helpless.

We will now consider (1) the reasons which have led to this peculiarity, and (2) the results. For the reasons we may perhaps best look back to the old patriarchal days of guilds and apprentices, when the learner was not only bound over for so many years, but was taken into the house, home and family circle of the master, as well as into the shop; and his mending and washing were done by the master's domestic servants, if not by his wife or daughters. In those days shops were small—most work was hand-work—and the shop and the house were in the same building, just as was the case with the merchant's dwelling and store or counting house.

The second reason is twined up with the first, and is that even now the manufacturer is not on the same social scale here as the "*rentier*" or landed proprietor, although he outranks, and will not always associate with, the store-keeper, even while the latter does not personally serve his customers. The small manufacturer cannot hope for himself, nor for his wife and daughters, the same social standing as the lawyer; and he looks down on the store-keeper, as the banker looks down on the lawyer, and as the army officer looks down on all of them. No amount of living on fashionable streets, nor of going to fashionable resorts, will wipe out the fact that the manufacturer is here only a manufacturer, so there is nothing to be gained by *not* living over or next to the shop.

What is there to be gained by living within ear-shot?

Commercially, much. The German work-day begins at six A. M. ("'Arly Marnin'," a Hibernian in Chicago interpreted these letters); and as many a German machine-shop proprietor is his own foreman, or superintendent, it would be inconvenient to be at the shop at six A. M. if one lived in a suburb. And to be within sight of the exhaust and the stack, and within ear-shot of the hammer-clang and all the hum and bustle of the shop, even when one is not right in the building, is an advantage by being a check on employees. In case of an emergency, an accident, an unexpected visit, a fire, a strike, or any one of a dozen or fifty of the unlikely or even "impossible" things which are always happening, it is a distinct advantage to be within sight or call.

I anticipate the objection which some will raise at once, that

especially in feverish America and in these days of anxiety, when business men live like a lot of snakes in a jar, each one trying to get his head above those of his fellow-strugglers—being right at the shop would make a man work too many hours a day, and get nervous prostration, to say nothing of neglecting his family.

As a matter of fact, it does not work that way. "On the contrary, quite the reverse," as Misther Muldoon would say. When you find a German neglecting his family, kindly mention it and I will show you a white blackbird. It is a matter of common knowledge, however, that one of our most prominent American machine tool builders, whose fine house was in a neighboring town to his shops, had a room fitted up at the shop, so that he could stay all night in case he had to work late, and that very often he spent more nights in his "emergency" quarters than in the lap of luxury and the bosom of his family. And *he* got nervous prostration.

As the opposite side of the picture, drop down to Bridgeton, N. J., and see how the president of the Ferracute Works enjoys his *otium cum dignitate* at "Lochwold," his house overlooking the lake, and but a stone-toss from the shops. I am sure that neither Mr. nor Mrs. Oberlin Smith have thought for a moment that they were carrying out the German idea; and am equally sure that many an American machine-shop proprietor who has to catch the 8:13 train, or drive through a bad road, or cycle a few miles in the sun or in the rain, in order to get to his shop, would turn green with envy if he were to pass a day at "Lochwold."

There are of course exceptions (some would call them brilliant ones, but I will reserve my judgment) to the rule. Borsig, the "locomotive king" of Germany, built a palace in Berlin, on the same street with the lordly residences of Fuerst Bismarck, Prince Pless, and others of the *haut ton* of the German capital; but I don't envy the family the smell from the Pless stables. Krupp, the "cannon king," lives a goodly drive away from the thunders of the great hammers at Essen; Naumann, grown rich with sewing-machine and bicycle making, and rejoicing in the title of "Commerzienrat," inhabits an elaborate villa (so-called Gothic, although the Goths never had any architecture, and indeed burned and pulled down more than they built) on the heights overlooking the Elbe, a short drive from Dresden; but these and all the other shining examples are, I think, exceptions to the general rule, that German machine shop proprietors live right near their shops.

* * *

THE BIGGEST PUMP IN THE CITY.

JOHN LOOKABACK.

Johnson put a three-horse engine and boiler in for a firm manufacturing in a small way, in the lower part of a near-by city. The engine was new and rather nice, but the boiler was second hand, and—well, it was considered as being in the line of precautionary wisdom to limit the allowable pressure to 50 pounds. But as that was more than enough for the engine, it did not matter much. If the pressure had been higher the engine would have throttled it down. The little pump, driven from the crank shaft, never seemed to work as a pump ought to work; had to choke down the supply-pipe cock and close it when the engine was shut down, or that pump seemed to go right on working, making up for lost time like. They got along somehow till one morning, after an unusually cold night, word came to the shop that the pump had "froze up"—gone to pieces generally. Old man Jackson was sent to the works with an injector under his arm. "Got to get water in that boiler somehow till another pump is made," Johnson said. Jackson pulled the pump out of the way, spliced out the suction pipe to connect with the delivery pipe and notified the parties in interest that they could start running.

"But where's the feed pump?"

"Got the biggest feed pump in this city," said Jackson.

Jackson was right. The pressure in the main from which they had been "pumping" water for three months to feed against 50 pounds pressure in the boiler was 75 pounds.

* * *

Mr. Fred J. Miller, editor of the *American Machinist*, has returned from his extended trip in Great Britain and on the continent of Europe. The letters that Mr. Miller has contributed to the *Machinist* during his trip are unquestionably one of the most interesting and valuable series ever published by any technical journal.

SEEN IN VARIOUS SHOPS.—4.

A FEW NOTES FROM WASHINGTON, WITH COMMENTS ON THE METHODS OF UNCLE SAM.

A. HARDCASE.

THE WASHINGTON NAVY YARD.

The gun shop of the Washington Navy Yard is provided with three traveling cranes built by the Morgan Engineering Works, the largest being of 110 tons capacity. The other two, 40 and 20 tons capacity, are driven by a single square shaft 640 feet long, and operate on the same track the entire length of the building. The heavy gun work is done on the floor of this department, where the largest lathe in the entire works is to be found, and is said to have cost $87 000.

By observing the different lathes in operation the cutting speed was noted to be about 8 to 12 feet per minute, which seems slow to a visitor watching the chip curl off from the large steel guns; but he must bear in mind that it is special stock and fairly hard, yet not so hard as much of the steel that finds its way to the average machinist.

The shops are open to visitors, but none of the employees except the foremen and officers are permitted to hold any conversation with them, and even the foremen are not allowed to give out any information whatever concerning the work; yet the workmen do not appear to chafe under their "harness" as much as one would suppose; neither does the presence of visitors seem to interfere with the work in the least.

HOW THE MECHANICS ARE HIRED.

Seven hundred mechanics would probably be a fair estimate, although there appeared to be about one thousand hands in all employed about the yard when these notes were taken, and from questions that I have often heard in the shop I presume that many machinists would like to know whether or not a position at the navy yard would be desirable. To such the question of wages is probably of the greatest importance, and it is doubtful if the same man could do any better there than elsewhere—everything considered. The four rates of wages paid are $2.32, $2.56, $2.80 and $3.04 per day, the average being about $2.80 or less. Eight hours constitutes a day's work, and to obtain employment one has to register at the "labor board" in one of the four classes, and wait until his turn comes, on a plan similar to the civil service rules, the best of the old hands having the first chance in each class. That is, if a foreman calls for a second class man, one is chosen from those registered as second class, even if 500 names are registered on the first class list with perfect records as old hands. The one selected is the one having the best record as a former employee, but if no old hands are registered, the first one registered in that class as a new hand is chosen and sent to the foreman wanting him, who is given one week to report whether or not he is satisfactory. If he is not satisfactory he is discharged and another tried, etc., until one is found that is. If my memory serves me right, no apprentices are taken. I believe that comparative ability, poor work, misconduct, lost time, breakage, and all such things are noted and determine a workman's record, which is one of the good features observed.

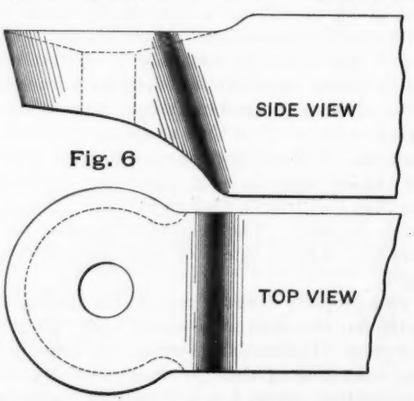


Fig. 6

With the exception of the tool shop, the machine work done there is quite different from that done in most shops, and the care taken to get every curve and corner in the outline of the big guns exactly alike seems almost like a waste of time, and some of the round nose tools used are of more interest than the work they do. Some of those noticed were forming tools fully three inches across the point, and were made like Fig. 6; the point forged solid with the shank has a hole bored through the

center, which serves to steady the counterbore used to produce the top rake that slopes downward from the cutting edge towards the hole in the center. By using a stud or arbor in this hole the bottom rake conforming to a true circle is easily obtained and accurate regrinding an easy matter, although the radius of the cutting edge is somewhat changed by it.

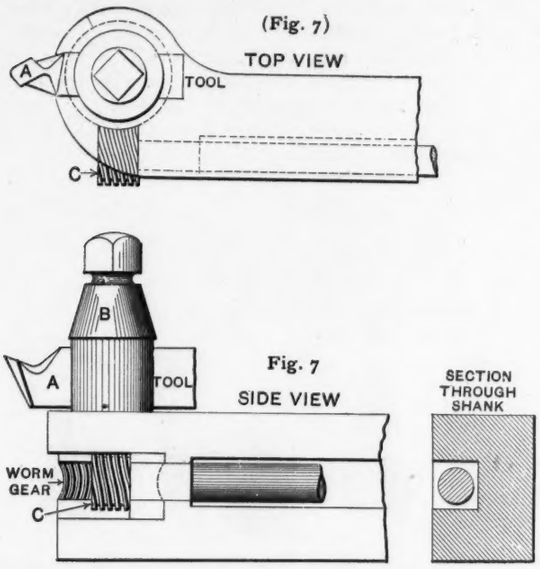


Fig. 7

In Fig. 7 the radius is adjusted to suit the work by the amout that the cutter A projects from the tool-post B, which is revolved by means of the worm C, cutting like an ordinary lathe tool instead of a former (sketches drawn from memory).

SYSTEM AND DISCIPLINE.

The men have no fear of being cheated out of their pay, and instead of a cut-down, those who are not capable of giving satisfaction in some one of the four grades are discharged and their places filled by men who can, which is one method that could probably be adopted in many shops to the mutual advantage of all concerned.

There is no piece-work, and strikes play no part in the shops of Uncle Sam. Like everything else run by the Government, I suppose that even the Washington navy yard is not entirely free from red tape. No matter how much a job is wanted, if the simplest sort of a mistake in the drawings is found, it must be reported and work stopped until the necessary changes come through the proper channel, which may take months, even if it might have been disposed of in fifteen minutes by the foreman or draughtsman, who could report the change and have the drawings corrected at leisure. System and discipline are good things and very agreeable to the writer, even if they serve no other purpose than to keep the rest in their places and let him do the same; but when it comes to red tape, the freedom of a huckster's life is preferable.

I hope that I have said enough to call out something of interest to mechanics from those who know what it is to work at the navy yard or other Government shops; what I have said being obtained from a short visit only.

THE BUREAU OF ENGRAVING AND PRINTING.

When I hear a machinist laugh at the idea of a mechanic studying such things as algebra and geometry, I feel like asking him to take a sample of our paper money and examine closely those intricate circles and curving lines upon it. They are geometrical designs, and the only parts of the engraving from which it is printed that is done by machinery, and are almost impossible to counterfeit. How many of those who scoff at an education for mechanics know how much the Government pays the man that produces them, or what problems enter into their construction, known as engine turning? The geometrical lathe used in doing the work at the Bureau of Engraving and Printing can be seen only by special permission, which is not easy to get, although the writer was fortunate enough to obtain it through the kindness and influence of one of those in charge. The favor was appreciated, but I withhold the gentleman's name to save him the annoyance of similar demands upon his good nature. These designs are engraved with the lathe, but the operator must figure out his own design to fill a specified shape of given size, which is no easy problem, and then set the lathe to produce it. All that is given him is the shape and size of the space to be engraved, and if the first design is not satisfactory, he must try until he gets one that is.

The lathe in question is not much larger than a typewriting machine, and in shape resembles one more than it does a lathe. It is useless for me to try and explain, to one who has never seen it, how this expensive and complicated machine is built or works, and as it is believed that there are but two of them in the United States, the space will be put to better use if devoted to more common problems.

THE MANUFACTURE OF POSTAGE STAMPS.

Postage stamps are another well known production of the Bureau of Engraving and Printing, and the method of making the perforations between them is probably the part most interesting to machinists, but like the geometrical lathe can be seen only by special permission, for the visitor must enter the room where the inspecting, counting, pressing and other work is being done, to examine it. The perforating machines are comparatively simple affairs, and the amount of work done requires quite a number of them, although a sheet of 400 stamps is perforated by running it through a machine twice.

The stamps, printed and gummed in sheets of 400, are passed through a gang of rolls about four inches in diameter. The top rolls contain a row of round steel plugs or punches that run in corresponding rows of holes in the rims of the rolls below, by which they are driven like spur gears. The size and spacing of these holes can be readily seen by examining a sheet of postage stamps, and the distance between the rows of holes is adjusted to suit the length or width of the stamps by setting the lower rolls on their shaft with the proper distance between them, while the top rolls run free, guided only by the punches, so that any little "wavers" in the running of the lower roll are readily followed by the punches, which would not be the case if each roll were rigidly secured to its shaft.

This plan of using a free running top roll is one of the practical ideas of the machinist, Mr. E. E. Burgee, that ought to be appreciated for the time and annoyance saved.

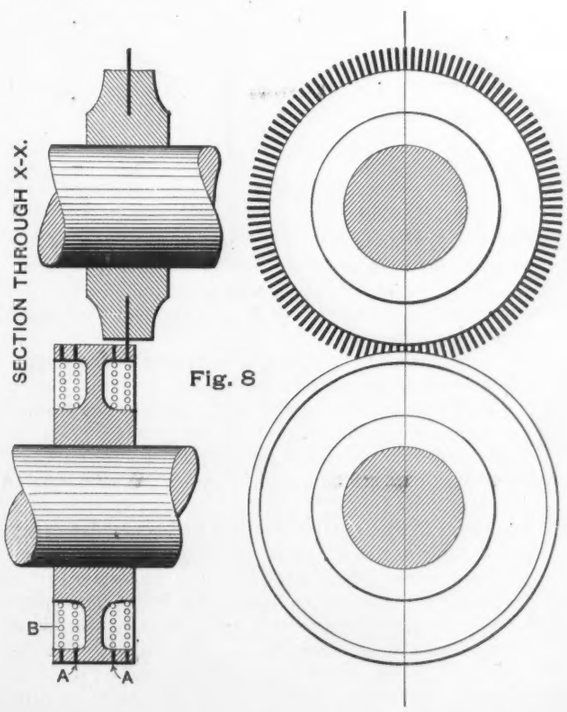


Fig. 8

A mechanic's interest would probably center in the lower or die rolls, because they are made of brass and would seem a poor material as a die for punching paper; but it is a hard, "short" brass, and a single row of holes is said to do satisfactory work for about two months. Another row of holes in the other edge of the rim adds another two months to its life when the edges are turned off and two more rows A A, Fig. 8, are drilled, making it good for four months more.

Fig. 8, drawn from memory, shows the construction of a pair of these rolls; the lower one having a thin rim like a pulley, connected to the hub by a web. The holes are drilled entirely through the rim, preventing the holes becoming filled with the little discs punched from the paper.

After they are perforated, a number of the sheets are placed in a press under a sheet of hard material, then another lot of stamps with a similar sheet over them, etc., until the pile is several inches thick, then a pressure of tons applied to the mass, which smoothes down the burr raised by the punches. A trace of this power can be seen on the gummed side of most stamps in the impression made by the holes in the sheet next to it.

The engraving and other work done at the Bureau of Engraving and Printing is probably as good as any of its kind done in the world, and the specimens of it sent abroad in the form of money, bonds, revenue and postage stamps is a fitting display of the work of American mechanics.

* * *

BRASS WORKING TOOLS.—3.

FRED H. COLVIN.

It is pretty safe to say that the great majority of brass work is now done on turret lathes and as the tools for this work have to be made by the tool-maker, a few examples and suggestions might not be amiss.

Take common brass nuts for pipe unions, where they are made light for economy of metal, and the problem of holding them without squeezing them out of shape. They must be held firmly or the cutters will loosen them in the chuck. Fig. 1 shows a hexagon nut held in common hex jaws. Fig. 2 was intended to show the nut squeezed out of shape but the engraver evidently thought this was a mistake and straightened it up. But they do get squeezed, nevertheless, and make trouble for the turret-hand. By cutting the jaws away in the center, as shown in Fig. 3, the pressure comes in a direct line with the sides and the jaws are not nearly as apt to squeeze the nuts out of shape.

The holding of work is quite a problem in itself, and this suggestion may give a hint in other cases.

The cutters for this class of work are generally flat, made from

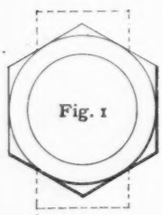


Fig. 1

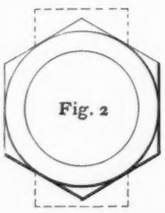


Fig. 2

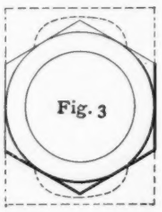


Fig. 3

steel about ¼ to ⅜ of an inch thick. The left hand tool of Fig. 4 is a flat cutter for such a nut as this, in a holder for a turret. This is a piece of round, soft steel, with a slot milled across one end, the other being usually bored for a round tool, such as the taps shown in the same cut.

Where it is important to have the hole tapped in exact alignment with the untapped portion, or square with the face of nut, it is a good plan to have a tit or guide made on the front of the tap, as shown in the fourth tool of this group. These tits can be interchangeable where the same tap is used for nuts having different sized backs, but for accurate work the solid tap and guide is to be preferred.

The other tools in this group are a long and heavy flat cutter, half an inch thick, for roughing out a casting; a sectional tap, having a body of machinery steel and four tool steel cutters inserted as shown, the advantage being that it can be adjusted to maintain its size and new cutters put in at a comparatively little outlay when the old ones are worn or broken. The last tool is a flat tap, made on the same principle as the flat cutters except that it is of heavier steel and has a guide in front the same as the solid tap. Of this, more may be said later.

The main question that interests the tool maker is how to make these tools easily and cheaply—that is his part of the business—and he is particularly anxious to know if he is not familiar with brass working tools.

Having a cutter like the left-hand one in Fig. 4 to be made, the first step is to select your steel, take the right length and width and center it the same as for any piece of work, being sure to get a good center and as deep as you can in the thickness of the steel, for this work is hard on centers. Better keep a pair just for flat cutter work.

The handiest way of driving the steel is shown on Fig. 5. This is simply a piece screwed on the spindle nose, bored to let the center project nearly through and slotted across the face to admit the piece of steel being set in and driven. Have both sides drive if you can, as this avoids the tendency to crowd off the center.

The next question is the tool, and there is some diversity of opinion regarding this. It is rather hard on any tool to have the work intermittent and to have it strike two blows per revolution, but this must be met with centers and tool firmly set, spindle screwed down tight enough to prevent jerking and the tail stock tightly clamped down to the bed.

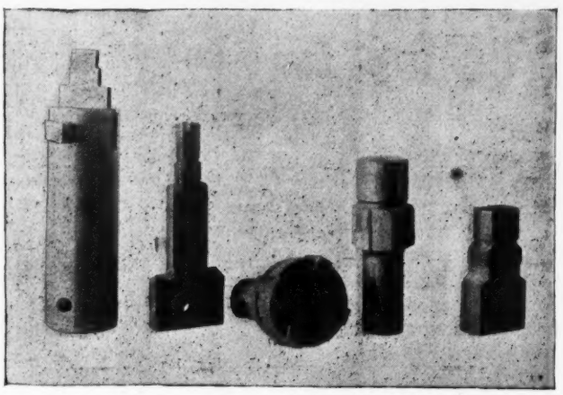


FIG. 4.

Some prefer a diamond-point tool for this as for all work. The writer has rounded the diamond a little and used it fairly well, but settled down to Fig. 6 as a steady diet. This is almost a square face finishing tool, but has the leading corner either rounded or beveled and the groove *a* is filed or ground previous to hardening; above all, the cutting edge must be well supported to obviate spring and breakage. The object of groove *a* is to allow frequent grindings (and flat turning generally requires it), without materially altering the rake of tool or having too much to grind. The dotted lines show how this can be accomplished. The corner does not want to be rounded or beveled very much, just enough to prevent it from breaking easily, as it would if it were perfectly square.

Having the tools, the steel for the cutter and the means for driving it, no further directions are necessary as any mechanic can turn them up. They need practically no clearance on the sides, except to ease off down the center of the sides, as the flat steel is apt to spring a little and leave the center high.

The cutting edges are made by filing back, as shown in the second tool of Fig. 4, and let it be borne in mind that all flat tools—and most others for that matter—should be ground *on the top only*, not as the cutting faces. The sides should not cut but only guide the cutter in the work.

These flat cutters are, within a reasonable size, the best and most economical roughing tools the writer has used, as they always clear themselves so freely. The second tool of Fig. 4 is of half-inch steel, about 8 inches long and probably an inch in diameter at the point. Beyond this we never deemed it advisable to go. For larger roughing tools and also for finishing tools another form was always found more satisfactory.

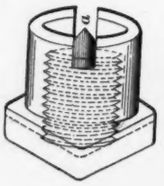


FIG. 5.

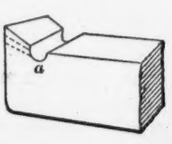


FIG. 6.

Fig. 7 gives in outline the details of construction of a bar, as much adopted for finishing, A being an end view of the plain bar and B a side view showing the cutter in place. It will be noticed that only one side of the inserted cutter is beveled or dove-tailed—the back side or side which receives the thrust. This is sufficient to hold it, makes it easier to increase the diameter by packing underneath the cutter with paper or thin metal and gives a square edge for the cutting portion.

The slot in bar should be fairly deep—say one and a-half

times its width—in order to hold it firmly. The length should be about 2½ or 3 inches for medium-sized bars, to allow for the cutter to be driven forward in case a piece breaks off the end, as sometimes occurs.

First, drill a hole *d* at the required distance from end of bar, on each side of bar. Scribe the lines along the bar and lay off your slot or keyway at the end, then plane to size the same as any similar slot. Always plane the slots so that a regular size of steel will fill bottom of slot, as this leaves only a very little filing or grinding necessary to make a fit. At C, a little forward of the drilled hole, a groove or notch is filed across the cutter to afford means of driving it out after it is once in place, and it may not be amiss to say right here, if you don't want it to stick or "seize" in the slot, don't neglect to either oil it or graphite it, before driving it home.

Where several sizes are required it adds a little to the problem and leaves various methods of solution. If the sizes do not differ materially, that is, are not over a half inch different in diameter (or having a step of one-quarter of an inch on each side) both sizes can be made in one cutter as shown at C, Fig. 7. This of course necessitates a deep cutter to give strength for the smaller diameter. Don't be misled into the false economy of making the groove like *e*, for any slight variation for endwise position affects the diameter and this prevents the possibility of moving the cutter forward in case of a break in front. Have the bottom of slot, like *f*, parallel with center of bar and obtain any increase in diameter by packing underneath as before suggested.

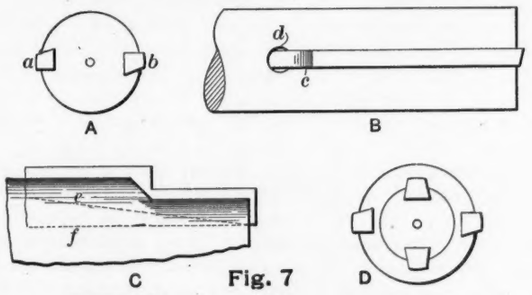


Fig. 7

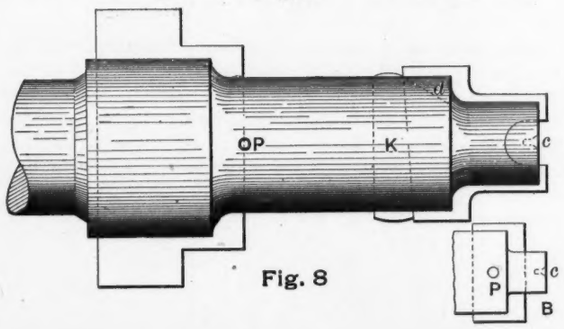


Fig. 8

Where there is any material difference in diameters it is better to use independent cutters as shown at D, Fig. 7, in an end view. It is better to have the different sets at right angles to each other to give ample room for planing and for driving out each set without disturbing the others, if it becomes necessary for renewal or sharpening, as they cannot always be ground satisfactorily in place. While this style is also used to some extent for roughing bars, the cutters are rather frail for this work, and a rougher, cheaper and stronger bar was used in most cases. This is shown quite clearly in Fig. 8. These are flat cutters mortised through the bar and two different styles are shown. The front cutter is the forked type, to present cutting edges ahead of the bar and is held in place by the key K. In this case the bevel is shown on the cutter; in some instances it is put in the bar, it being really a matter of indifference which is used. This preserves the original center in the bar, and this is desirable, as it is bad practice to destroy the center of the bar as some do, by slotting it out and inserting the cutter in the end, finding a new center in the cutter.

Another method of preserving the center is shown at B, Fig. 8, in which the front end of bar is turned down small enough for the work in hand, and a plain cutter inserted and pinned in place.

In roughing out work the chips are very apt to clog on the cutters, and when this happens you might as well stop and clean them out first as last. By cutting away the corner *d* on the cutting side of bar, as shown by dotted lines, this can be avoided to some extent.

The back cutter is also a plain piece of steel mortised into the bar and held by pin P. This is placed at the front so as to force the cutter back against its seat in the bar and to also center it sideways by the small V slot into which it fits. These pins should be slightly taper for best results. The best reamers for these pin-holes are the half-round kind with a very small amount of taper. Some put the pin through the center of cutter, as shown in B, Fig. 8, but it is not as apt to be held firmly, being much more likely to move and "float" a little while at work, sometimes boring a larger hole than was intended.

Another interesting form of bar for a peculiar job will be shown later.

* * *

A SIMPLE TEST OF ENGINE FRICTION.

WILLIAM FOX.

The power absorbed by the friction of the moving parts of an engine may be readily approximated if the machine uses a fly-wheel.

The method is as follows:—

1. Before shutting down, test the speed of the engine, counting the revolutions per minute.

2. Through out of gear all but the parts whose friction you wish to determine.

3. As suddenly as possible turn off the supply (steam, water, or gas, as the case may be).

4. Count the number of turns the fly-wheel makes before the engine stops altogether.

Measure the dimensions of the fly-wheel and of any other pulleys and other parts whose moment of inertia is appreciable, when compared with that of the fly-wheel. Usually, only the fly-wheel need be taken into account.

At the moment of shutting down, the fly-wheel, and the other moving pulleys, are moving with a rim-velocity corresponding to the number of revolutions per minute. Calculate this speed in feet per second. The living force or kinetic energy possessed by the wheels is readily calculated: ½ times the weight of the rim, times the square of the rim-velocity (feet per second) ÷ 32.18. This represents energy in foot-pounds, which is expended in overcoming the friction and other resistances of the mechanism. These resistances are practically constant. Hence, the work accomplished per revolution will be simply the total living energy at the start divided by the number of turns over which this work is distributed, before it is entirely consumed, *i. e.*, before the engine stops.

Example:—

Fly-wheel diam. (D) = 42 in. cross-section of rim (A) = 3.75 sq. in.
Driving pulley $d' = 24$ in. " " $a' = 2$ "
Driven pulley $d'' = 26$ in. " " $a'' = 2$ "
R. P. M. (N) before shutting down = 300.
Of the driven pulley (n) = 240.
Number of turns before stopping (T) = 50.

Assuming the weight of one cubic inch of iron = .26 pounds, we have weight of the fly-wheel rim (W) = $.26 \times 3.14 \times 42 \times 3.75 = 128.6$ pounds; we have weight of the driving pulley rim (w') = $.26 \times 3.14 \times 24 \times 2 = 38.2$ pounds; we have weight of driven pulley rim (w'') = $.26 \times 3.14 \times 26 \times 2 = 42.5$ pounds.

Vel. of rim of fly-wheel (V) $= \dfrac{3.14 \times 42 \times 300}{12 \times 60} = 55$ ft. per sec.
" " driving pulley (v') = 34.4 " "
" " driven " (v'') = 27.25 " "
Energy of fly-wheel = E = ½ WVV ÷ 32.18 = 6050 ft. lbs. (appr.)
" driving pulley = $e' = ½ w'v'v' \div 32.18 = 585$ " "
" driven " = $e'' = ½ w''v''v'' \div 32.18 = 556$ " "
Total energy = $E + e' + e'' = 7191$ ft. lbs.
Work of friction per revolution = 7191 ÷ T = 144 ft. lbs. (appr.)

The rate of the engine being 300 R.P.M., we can calculate the HP. absorbed by friction = 144 × 300 ÷ 33 000 = 1.3 HP.

* * *

PLANS are being perfected for a Trans-Mississippi and International exposition to be held in Omaha from June 1 to November 1, 1901. There are to be seven main buildings costing $100 000 each, including a machinery building, besides many smaller structures. The projectors expect that the subscriptions will reach $1 000 000.

HOW TO CALCULATE, DESIGN AND CONSTRUCT ELECTRICAL MACHINERY.—4.

Wm. Baxter, Jr.

In the preceding article we explained the action of an armature in a two-pole machine, and also gave the rule for calculating the E. M. F.; in the following, the operation of machines having more than two poles, which are known as multipolar machines, will be explained, and the rule for calculating the E. M. F. developed in them will also be given.

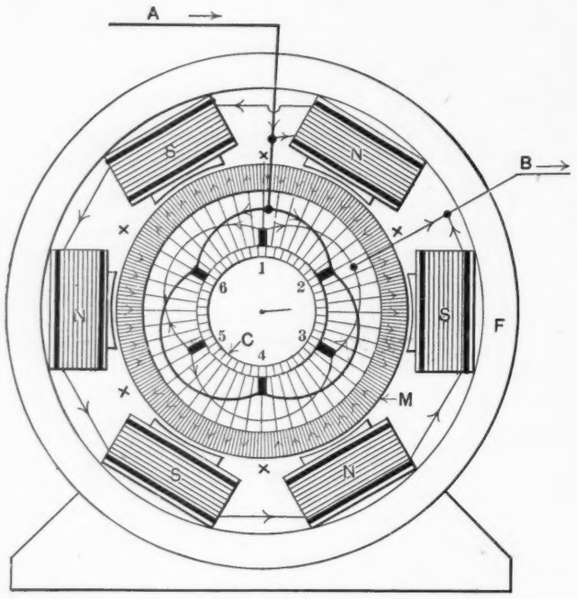


Fig. 29

Multipolar machines may have any number of poles from four upward, but for reasons that will be explained at the proper time, more than twelve poles are seldom used. Fig. 29 shows a six-pole machine with a ring armature. As will be noticed, the N. and S. poles alternate around the circle, and this order is followed, no matter what the number of poles may be. The wire coils that magnetize the field are shown wound upon the poles, but they can be placed upon the ring F just as well, and in many cases this construction is followed, although it is not the most advisable, owing to the fact that the mechanical difficulties of construction are increased, and a greater amount of wire is required to obtain the same magnetizing force.

polarity of the field it is moving through at the time, it is evident that, at the three points opposite the N. poles, the direction will be the same, and at the three points opposite the S. poles it will be also the same, but in the reverse direction to that induced under the first named poles. On this account the current will enter the armature through three brushes and leave it through the three intermediate ones. A little reflection upon the foregoing will show that each pair of N. and S. poles is the equivalent of a two-pole machine, and that the armature is, substantially, three two-pole armatures combined in one. In a two-pole machine the current passes through the armature in two separate branches, and in a multi-polar machine it passes through in as many branches as there are poles, and therefore there must be as many brushes as there are poles. It will also be seen, at once, that the number of poles must be even, that is four, six, eight, etc., but not five, seven or nine.

If the wire on the armature of a two-pole machine is divided into forty sections, in a six-pole machine it will have to be divided into three times this number, to be in the same proportion. As the number of commutator segments must be equal to the number of armature sections, the two-pole machine would have forty segments in the commutator and the six-pole machine 120; that is, if the same proportion were to be maintained in both. If the commutator has three times the number of segments it must be three times the diameter. From this it will be seen that if the number of poles is greatly increased, the commutator will assume very large dimensions, and it is mainly on this account that the number of poles is seldom made greater than twelve. The number of divisions in each section of the armature of a multipolar machine is generally made smaller than in a two-pole machine, so as to keep down the diameter of the commutator, but too great a reduction in this line cannot be made as it would result in producing objectionable sparking at the brushes.

If it were not for the increased size of the commutator, the number of poles in multi-polar machines would be made very much greater, because by so doing the capacity of the machine can be greatly increased, in fact this is the advantage of the multi-polar construction. The way in which the increased number of poles increases the capacity can be understood from the following.

As has already been stated, the E. M. F. developed by the armature at a given velocity of rotation, is proportional to the number of wires upon its outside surface, and the number of lines of force in the field. Now, considering Fig. 29, suppose the three N. poles were placed together at the top, and the S. poles at the bottom, so as to form a two-pole machine. Then the wire on the armature would pass through the N. field once in each revolution, and through the S. field also once, thus cutting

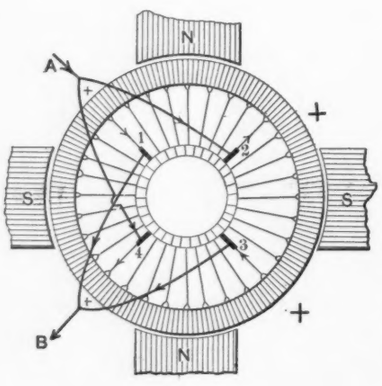


Fig. 30

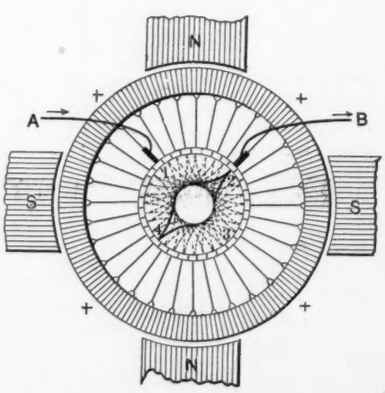


Fig. 31

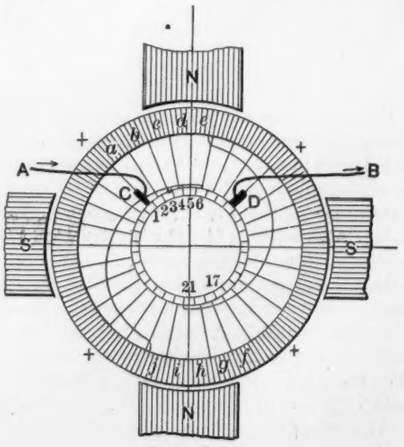


Fig. 32

It will be noticed that the commutator has many more segments than the one shown in the two-pole machine, Fig. 22, and there are six brushes bearing upon it instead of two. It will also be seen that the odd numbered brushes are all connected together, as indicated by the solid curved lines, and the even numbered brushes are also connected, as shown by the dotted curved lines. As the direction in which the E. M. F. will be developed at any point of the armature ring M will be dependent upon the

the lines twice in each revolution; but if the poles are divided as shown in the figure, the armature wire will pass through the N. field three times and the S. field three times, in each revolution; therefore the lines will be cut six times in each revolution, and the E. M. F. will be three times as great, if in both cases the same number of lines issue from each pole. Stating the case in another way, increasing the number of poles, their strength remaining the same, is equivalent to increasing the velocity of rotation.

From the foregoing, we can at once develop the rule for calculating the E. M. F. induced in a multi-polar armature, as the only difference between it and that given for two-pole machines is that the velocity must be multiplied by the number of N. poles.

The rule is as follows:

Multiply the number of wires on the surface of the armature by the revolutions per second, and by the number of N. poles, and by the lines of force of one N. pole and divide this product by 100 000 000, and the result will be the volts.

The above rule gives the sum of the E. M. F. induced in the several sections of the armature, but if the brushes are connected as shown in Fig. 29, the actual E. M. F. will be just the same as in the case of a two-pole machine, being the product of the number of wires by the revolutions and the number of lines of force issuing from one pole. In such a case the advantage of using an increased number of poles is derived, not in the form of an increased E. M. F., but of an increase in the number of circuits in which the current is generated, hence in an increase of current. In the two-pole machine there are but two circuits in the armature, in the six-pole machine there are six; therefore the current carrying capacity of the latter is three times as great.

When the various divisions of the armature of a multi-polar machine are connected as shown in Fig. 29, with the even numbered brushes all connected to one wire, and the odd numbered brushes to the other wire, the armature is said to be connected in parallel, because under such conditions the E. M. F.'s developed in the several sections work side by side and do not increase the pressure—only the current. When the connections are such that the same current that passes through one division of the armature follows in succession through all the others, the connection is said to be in series, and then the E. M. F.'s of all the divisions are added to each other, and the resulting E. M. F. is that obtained by the rule above given. It will thus be seen that it is necessary to remember that if the armature is connected in parallel, the rule for calculating the E. M. F. is the same as for a two-pole machine; but if it is connected in series, the last rule is to be used.

The difference between series and parallel connections can be made clear by means of Figs. 30, 31, 32, which are simple representations of four-pole machines. Figs. 30 and 31 show two modifications of the parallel connection, the difference between them being that in the first, four brushes are used, and in the second only two. The first, it will be noticed, is the same as that shown in Fig. 29, the current from wire A passing to brushes 2 and 4, while from brushes 1 and 3 the current passes to wire B. As it is more or less objectionable to have a multiplicity of brushes, the arrangement shown in Fig, 31 is very often used. In this arrangement the sections of the commutator are joined by wires or strips of sheet metal, the process being known as cross connecting the commutator. In the case of a four-pole machine the segments diametrically opposite are connected, as shown by the dotted lines, and more perfectly by the solid lines between 2 and 4. If the machine has six poles, the segments separated by one-third of the circumference must be connected, and for an eight-pole machine, those ninety degrees apart. In a four-pole machine only two segments will be connected with each other, so that all the segments of the commutator will be connected in pairs, each one with the one opposite to it. In a six-pole machine there will be three segments connected in each group, and they will be separated from each other by one-third of the circle. In a four pole machine there will be four segments in each group, and they will be ninety degrees apart. In any case, the number of segments connected in each group will be equal to the number of N. poles, and they will be equally spaced around the circumference, and all the segments must be connected in the same manner.

To connect an armature in series, the connections are made, not between the commutator segments, but between the armature sections. The first impression would be that all that would be required to accomplish this result would be to connect the end of one division of the armature to the beginning of the other, and this would be true if each division were connected to a separate commutator, for then we could connect the brushes of the several commutators so that the current would pass from one to the other in succession; but as all the armature divisions connect with the same commutator this arrangement cannot be used, and a connection must be adopted that will cause the current to circulate through the wire in the proper direction, no matter on what part of the commutator the brushes may be resting. This style of connection is difficult to understand, but once being mastered it will be found to be very simple. A little reflection will show that in order to preserve the same relation between the sections in the several divisions of the armature at all points, it will be necessary to so connect these sections that the current will pass through the first section of all the divisions first, then through the second section of all, then through the third, and so to the end. In the case of a four-pole machine, as shown in Fig. 32, the connections must be such that the current entering through the wire A will first pass through the section *a* and then cross over to the opposite side of the diameter, where it will enter section *f*, which is the corresponding section of the other division of the armature. After passing through section *f* it must cross over to the first division and pass through section *b*, and from here cross over again to section *g*, thence back to section *c* and again across to section *h*, back to section *d*, then to section *i* and so on all the way around to the starting point. The manner in which these connections are made is as follows: The ends of the sections coming from the outside of the armature are carried down to the commutator segments as shown by the solid lines in the figure, so that the end of section *a* is connected with segment 1 of *b*, with 2 of *c*, with 3, etc. The other end of the sections, which come from the inside surface of the armature, are carried half the way around the circumference and are connected with the commutator segment to which the front ends of the corresponding sections in the other division connect. Thus, the front end of section *a* connects with segment 1 and the back end with segment 17, to which the front end of section *f* is also attached. This is shown more clearly by the connections between the commutator and sections *e* and *j*. It will be noticed that the front end of *e* is connected with commutator segment 5, and that the back end, as shown by the dotted lines, passes around to segment 21, which also connects with the front end of *j*. The back end of *j* passes as shown by dotted line to segment 6, to which the front of section ahead of *e* is also connected.

When an armature is connected in series, the number of sections into which the wire is divided is odd, being one less than the number that would be used with a parallel connection. The number of commutator segments is also odd. The object of this is to render the connections at all points uniform. If the whole number of sections were retained, there would be one point where two sections, side by side, would have to be connected, and this would not only destroy the symmetry of construction, but would also cause some disturbance in the running of the commutator, because at this point the tendency to spark would be less than at any other, and this inequality would interfere with uniformity of action.

In Fig. 32 there are thirty-one sections, the front end of *a* connects with segment 1 and the back end with 17, which is sixteen segments ahead. The back end of section *f* is connected sixteen segments ahead of 17, to which the front end is connected; this brings it to segment 2, but if the total number of sections were thirty-two, then this last connection would have to be advanced seventeen segments instead of sixteen. Now if the connections on one side were sixteen in advance, and on the other seventeen, it follows that when the last connection was reached there would be no segment for it to connect with, as all the segments on that side of the circle would be filled, therefore it would have to be connected with the segment next to it, which would be the only remaining one.

The series connection of armature is used in railway motors, and to some extent in generators, although in the latter the parallel connection with as many brushes as there are poles is the almost universal practice. A series connected armature cannot be used with more than two brushes, and a parallel connected armature cannot be used with less brushes than the number of poles, unless the commutator is cross connected.

In cross connecting either the armature or the commutator, it is necessary to be very careful that only those sections that are to be connected come in contact, if not, the armature will be short circuited, and the result will be a burn out.

So far only the ring type of armature has been considered, but before taking up the subject of determining the strength of a magnet, or in other words calculating the number of lines of force, we will explain the drum type of armature. The ring type was taken up first because the winding of this class is easier to understand.

ECONOMY IN THE GENERATION AND USE OF STEAM.

W. H. WAKEMAN.

Some time ago, while conversing with an engineer in charge of a steam plant, he made the remark that this idea of one man striving to do better work in a plant than another, and so making himself superior to others, was all wrong, as in his opinion all men were equal and should be considered so and paid accordingly. Now this may sound well to some and probably does to those engineers who are too "shiftless" to study and work to improve their condition. While this theory may please the minds of some, let us not forget that although theories concerning these matters may do for the purpose of making speeches and passing away spare moments, it is the solid conditions that we have to deal with, and which will affect our ability to earn a good living; for an engineer who can run a plant with the least expense for fuel, and the smallest repair bills while keeping the machinery in good order, is the man that steam users are looking for, and to whom they are willing to pay the largest salary. It seems sometimes as if there were many exceptions to this rule, and we admit that there are some, but it is a well defined rule nevertheless.

It is not the object of this article to point out how a new plant should be designed to produce the best results, but to call attention to some things that might be done better than they sometimes are, and to suggest some changes that will prove beneficial under proper conditions.

The chief engineer who takes charge of a plant that is new to him, but which has been run for years in a certain way, will find many difficulties in the way of making changes that he knows will be for the best interests of his employers, owing to the prejudice of his assistants, who are naturally antagonistic to anything new in such matters. This is one reason why the proprietors should give their chief engineer full control over the plant. This should not be construed to mean that a new chief ought to inaugurate his career by turning all ot the old hands out and putting in new ones, for in a majority of cases this would not be advisable; but if it is known that the chief has full power to hire and discharge his assistants, and firemen, he will have much less trouble in having his directions carried out in detail, than if they understand that they can do things to pester and annoy him, and still hold their positions. Many a good, thorough, competent chief engineer has become disgusted with unnecessary trouble and care put upon him in this way, and given up his large plant to take charge of a smaller one, where there will be more chance for him to live out his allotted years in this beautiful but sometimes uncongenial world of ours.

In making a somewhat thorough canvass of what might be done to improve the economy of a plant, it may be well to begin with the coal used, and it should be definitely known whether the most economical kind is being used or not. The plan of running one week with one kind of coal and then running the next with another kind and noting the cost of the two, without giving close attention to the amount of power developed, may be satisfactory to the bookkeeper, but it never should be to the chief engineer. In one large plant in the vicinity of where this is written, there were twenty boilers in one boiler room and one in another. This single boiler was fitted up to make coal tests with, so that if any question was to be settled concerning the value of a certain kind of coal, there was no guess-work about it, but a test was at once made, and the exact amount of water evaporated into dry steam, per pound of coal, was determined, and also the exact amount for one dollar's worth of coal. These are two important points, and the difference between them should be noted. While one kind may evaporate more water per pound of coal, it may not be the cheapest to use, because of high price, while another kind may be the most economical, for although it may take more of it to evaporate a given amount of water, still on account of its low cost it may evaporate more water for each dollar's worth of it burned. If the duty is low with all kinds of coal, a careful investigation should follow in order to locate the cause, for it may not be apparent at first sight. To know this it will be necessary of course to know how many pounds of water are evaporated per day, and also the pounds of coal burned under all of the boilers. It is an easy matter to have the coal weighed as it is wheeled in, and it is not a difficult matter to arrive at the water disposed of, but still it requires some care.

The practice of connecting up a water meter and relying wholly on its readings should be condemned as unreliable, for while it usually is not practicable to weigh all of the water used in a large plant, a tank of known capacity should be provided, and at stated intervals (say once a week) the meter should be tested by filling the tank and noting the amount indicated on the dials. A comparison of the two amounts will enable the engineer to correct the readings of his meter and thus credit the exact amount of water evaporated.

The steam should be tested for moisture as many times as the boiler shows a high duty, until it is found that much of the water is carried over with the steam) but is not evaporated.

The grates should receive their share of attention, for if they have too wide air spaces the coal will be wasted, and on the other hand if the air spaces were narrow when new they are sure to be no wider now, and possibly they may be so nearly closed up in places as to fail to allow the air to circulate freely, hence the coal is not burned to the best advantage.

If the conditions are right for it, shaking or dumping grates may be a paying investment, and if so they should be used. It might be well to fit up one furnace with them, and compare results with the furnaces fitted with the stationary bars. This will be good evidence either for or against them. The grate surface may be too large or too small to secure the best results; but right here I will remark that unless it is very much too large, there will be no benefit derived from making it smaller, and unless the other extreme has been adopted we can expect little or no improvement from a change. The idea that a boiler needs coal according to the amount of grate surface under it, is a great mistake.

It is quite possible that the firemen are not handling their fires to the very best possible advantage, either in their mode of firing or in cleaning them, and if not this will make quite a difference in the coal account.

With certain kinds of fuel it is necessary to clean tubes often and to clean them thoroughly. A neglect of this will result in the use of more coal than would be called for otherwise, and if scale covers the internal parts of the boilers, it can hardly be expected that the highest economy will be secured.

Some engineers may think these suggestions superfluous, and to them they may be, but as long as plants can be found where two firemen are allowed to go to a furnace, pull the door open and one shoveling right handed and the other left handed, fill it with coal until the dead plate is covered, and then not stopping until a good sized pile has run out to the floor, we think that suggestions are in order. In the case above referred to, it required the united efforts of the firemen to close the door.

* * *

MECHANISM FOR MECHANICS.—7.

PROF. CHAS. H. BENJAMIN.

SPIRAL AND STEPPED GEARING.

Short gear teeth similar to those given in the table of dimensions are necessary when heavy pressures are used, on account of their greater strength. These short teeth have a short path

FIG. 24

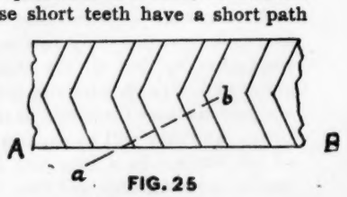


FIG. 25

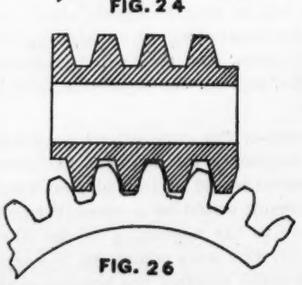


FIG. 26

of contact, and usually only one pair of teeth is in contact at one time.

The action may be improved by "staggering" or "stepping" the teeth, as it is called. This is equivalent to putting a second gear alongside or close to the first one, in such a way that the teeth of the second gear are opposite the spaces of the first one. See Fig. 24. A tooth on the second gear is then in the middle of its contact at the instant when a tooth on the first gear is leaving contact. In practice the gear is usually all one casting.

It is possible to carry this principle still further by having

more than two steps to the teeth, but a more convenient and practicable method is to use spiral teeth. Each tooth of the gear, instead of running straight across the face of the gear parallel to the shaft, is now a spiral similar to the teeth of a spiral mill. If the two wheels which gear together are on parallel shafts, one must have a right hand and the other a left hand spiral. The slant or obliquity of the teeth is usually such as to bring the last end of one tooth opposite the first end of the adjoining tooth; that is, the tooth deviates from a straight line just one pitch in the width of the gear face. This slant of the teeth causes a side pressure on the gear which tends to spring it or slip it along the shaft. To obviate this the teeth are usually made of two spirals, right and left, forming what is popularly known as the "herring-bone" tooth. See Fig. 25. These teeth are somewhat difficult to mould, but are smooth-running and strong.

Spiral teeth cannot be accurately cut with the ordinary cutters. The end of the tooth as cut by the plane of the wheel at A B, Fig. 25, is of the same shape as any gear tooth, but the shape of cross section at right angles to the tooth as at *a b* is slightly different. If, however, the obliquity is small, such gears can be cut with the ordinary shape of cutter without sensible error.

SCREW GEARING.

In the spiral gearing which has just been described, the spiral form of the teeth does not affect the velocity in any way; the shafts are parallel and the action is in all respects similar to that of ordinary spur gears. In case, however, the shafts are inclined to each other, or are at right angles and not in the same plane, the action is entirely different. The shafts not being in the same plane, the teeth now slide on each other sideways and the follower is driven by an oblique thrust from the driver.

WORM AND WHEEL.

The driver is usually much smaller than the follower and has only one or two teeth so oblique as to pass clear around the cylinder and form screw threads. This is called a worm and drives the teeth of the wheel by end thrust. The axes are at right angles and the velocity ratio depends wholly upon the number of teeth and not upon the diameter of the wheels. The slant or obliquity of the teeth upon the wheel is found by subtracting from 90° the slant of the threads on the worm, and the spirals on the worm and wheel are both right handed or both left handed.

In order to understand the action of such gear teeth and the shape which they should have, it is well to hold a screw or worm between the eye and the bright light from a window or gas-jet, and revolve slowly in that position. The rotation will not be apparent to the eye, but the observer will see the threads appear to travel from one end of the worm to the other. This is the motion which is imparted by the worm to the wheel, while the rotation of the worm has no effect. The wheel could be driven in the same way by pushing the worm endways without turning it, but the motion would not be continuous since the worm would have to be brought back in some way. The worm is nothing more nor less than a rack which gets its end motion by turning, and its action on a wheel is the same as that of a rack.

If, then, we make a section through the center line of the worm shaft and mid-plane of the wheel, the figure will be the same as that of a rack and wheel. See Fig. 26.

The threads of the worm are usually made with straight sides inclined at an angle of 15° like the teeth of an involute rack. The teeth of the wheel must then be involutes to correspond, and as the worm revolves, the outlines of its threads as seen in Fig. 26 will travel from left to right, gearing with the teeth of the wheel as a rack gears with its pinion.

PITCH AND OBLIQUITY.

In designing ordinary gear teeth the pitch diameter is usually made a whole number and this brings the circumference and the circular pitch in decimals.

In designing screw gearing it is more convenient to have the pitch of the teeth of wheel and worm common fractions, *i. e.*, a whole number of (as four or five) threads to the inch. This will usually bring the circumference of the pitch circle of the wheel a whole number, and consequently the diameter of the pitch circle will be a decimal. This can best be shown by an example.

Suppose that we wish to design a worm and wheel such that the wheel shall turn once for 80 turns of the worm, and that the pitch of the thread on the worm is ¼ inch, or as it is commonly said, 4 threads to the inch. Then if there be a single spiral on the worm there will be 80 teeth on the wheel, and the circumference will be 80 × ¼ = 20 inches. The diameter of the pitch circle will be

$$\frac{20}{3.141} = 6.37 \text{ inches.}$$

As the circular pitch is ¼ inch, the width of the teeth will be ⅛ inch on the pitch line, if there is no back-lash, and their height will be about ¼ × .7 = .175 inches.

The diameter of the blank before cutting will be 6.37 + .175 = 6.545 inches.

The diameter of the worm itself will not affect the velocity ratio and will depend on the size of the worm shaft.

The threads of the worm will be like the threads of an involute rack as shown in Fig. 26, and the teeth of the wheel will be involutes constructed as explained in the article on involute gears.

The teeth of the wheel may be simply spiral teeth of the right obliquity, cut with a milling cutter in the ordinary manner, in which case the contact will be only at one point and they will wear rapidly.

Usually a hob or tap, a duplicate of the worm, is used for finishing the teeth of the wheel, and in this case the teeth may be in contact along the whole of their length, making a much stronger and more durable combination.

With either mode of construction a drawing such as Fig. 26 will give all necessary information.

* * *

KNOTS AND MILES.

When we hear of a vessel making a new record of a certain number of knots an hour, we generally want to know just how much a knot is. It seems to be a point, however, concerning which very few can give any information, except, possibly, that a knot is "something over a mile." The following explanation, taken from the *American Shipbuilder*, is therefore worth making a note of: "A nautical mile is equal in length to one-sixtieth part of the length of a degree of a great circle of the earth. But the circumference of the earth is nowhere a true circle; its radius of curvature is variable; hence the nautical mile, as a matter of fact, depends for its length upon the shape as well as the size of the globe sailed over; and hence, strictly speaking, the length of the nautical mile should vary with the latitude, from 6046 feet at the equator to 6109 feet at the pole. Such extreme accuracy is not necessary in navigating, and cannot be well attained without undue labor. The British Admirality therefore have adopted 6080 feet as the length of the nautical mile, which corresponds with the length of one-sixtieth of a degree—or one minute of arc—of a great circle in latitude 48°. The United States Coast Survey has adopted the value of the nautical mile "as equal to one-sixtieth part of the length of a degree on the great circle of a sphere whose surface is equal to the surface of the earth." This gives the length of one nautical mile as equal to 6080 27 feet, which is very nearly the value of the Admiralty mile adopted in the English navy. Practically the nautical mile is 800 feet longer than the statute mile. In other words, one nautical mile is equal to 1.1515 statute miles; or one statute mile is equal to 0.869 nautical miles. Multiply nautical miles by 1.1515, and the product will be statute miles; or, multiply statute miles by 0.869, and the product will be nautical miles.

* * *

RULES AND FORMULAS (?) FOR STEAM ENGINEERING.

One might be led to believe that there was enough of crystalized practice in steam engineering to enable rules and formulas to be given that would apply to every detail of construction. This is far from being the case. Let any one look over a half dozen text books and the chances are that he can fashion the different parts about as he likes and find good authority for it. Every man who launches on the world a really successful steam engine makes for himself his own rules and formulas for the proportion of parts, and there isn't much of rule or formula about his manner of proceeding, either. He gets his own knowledge of what is best, or his idea of what he thinks is best, by the teachings of experience and observation. A great deal in steam engineering has yet to be gathered through the use of common sense. It is a good way from being a science.

THE HARTFORD CONVENTION.

ABSTRACTS FROM THE TOIPCAL DISCUSSIONS.

Prof. F. R. Hutton.—One of the members has sent in an inquiry as to the position which ought to be taken by competent mechanical engineers on the general question of its being worth while for inventors to waste their time and thought in the pursuit of a satisfactory rotary engine.

A recent work † covering subjects of this general sort has presented advantages and disadvantages of the rotary engine under the following heads:

1. The effort of the steam is applied directly without intervening mechanism, for conversion of the motions with their attendant friction, their costly fitting, and probable loss motion.

2. There being no reciprocating parts, there is no inertia to be overcome at the beginning of the stroke, with the attendant consumption of energy required to accelerate them.

3. The engine has no dead-center, but will start from rest in any position.

4. Absence of reciprocating parts makes it easy to run the shaft at the highest speed. This has attracted designers of steam-driven dynamos to use this type of engine.

5. The engine becomes very compact from the absence of converting mechanism, so that it occupies very little room.

6. The engine has either no valve-gearing, or that which it has is of the simplest character.

7. These features, and the absence of expensive mechanism, make the engine cheap to build and therefore usually cheap to buy.

8. Absence of reciprocating-rods and dead-centers results in a construction in which the presence of condensed steam in the cylinder does no harm. It does not stop the engine from turning, it cannot endanger the cylinder-casting, the engine can be started, even if under water, by simply opening the valve which admits pressure to it; it will start with solid water.

9. Its encased construction and the above peculiarities particularly adapt it for out-door service and exposed places. Weather does no harm, and its protection from outside injury makes it a serviceable quarry motor.

10. It requires no skill to handle it. If constructed to be reversible, it can be reversed from a distance by simple rope and weight.

The objections to the rotary engine are both practical and inherent. The practical objections belong to the difficulty of satisfactorily packing surfaces which do not move through equal spaces in equal times. Those parts farther from the axis move through a longer path in a revolution than those nearer to the axis. The wear from abraison is therefore greater at one part than another. When the packing-strips have become somewhat worn, leakage ensues, and a noisy rattle from looseness of the fits. A second practical difficulty is the expense connected with proper lubrication of such engines, and a difficulty of taking care of excess of oil rejected by the exhaust. If efficiently lubricated, they consume an excessive amount of oil.

The inherent objections to the rotary engine are :

1. The presence, in the volume to be filled by live steam from the boiler, of an excessive waste space which has to be filled by steam at each revolution, which steam is exhausted without doing all the work there is in it. This corresponds in reciprocating engines to an excessive clearance.

2. The very continuity of the action of the steam upon the rotating pistons precludes the possibility with the single rotary engine of working the steam expansively, so that when the steam leaves the motor it shall have become largely reduced in temperature and pressure by doing work with increase of its initial volume. The expansion is from the boiler and the water in it, and not from the actual volume received by the engine for the work of one stroke. In other words, the rotary engine is a non-expansive engine. These two difficulties make the rotary engine uneconomical.

3. It is difficult to design the rotary engine for large horsepowers:

First, because the structure becomes inconvenient the moment that large areas are desired, so as to make a value of $P A$ in the horse-power formula a large factor; second, because it becomes difficult to secure the condition of high piston-speed in feet per minute unless the diameter of the casing be made so large that the difficulties both practical and inherent become nearly insurmountable and the advantages of the rotary principle are sacrificed.

The economy which a single rotary engine cannot secure from its inability to work the steam expansively has been sought and secured in a degree by arranging rotary engines in series upon a shaft, so that the steam rejected from number one becomes the driving steam for motor number two of larger volume. By this means the steam when rejected is at more nearly the pressure and temperature of saturated steam at atmospheric pressure than can be attained with the single rotary engine.

In view of the existence of such disadvantages, both inherent and as yet unavoidable, how ought an engineer to meet the approach of inventors of rotary steam engines, if he wishes to retain a clear conscience and give sound advice? Have the words, "No Thoroughfare" been written over against the path towards a successful rotary engine?

TESTS OF THE EFFICIENCY OF THE BICYCLE.

Mr. John G. D. Mack.—The writer has had opportunity, during his professional work, to make a somewhat extended series of experiments upon the bicycle as a machine, and aims to present in the present paper a preliminary report of the investigation. While much of this information, and in a very much more extended scale, is in the possession of the best manufacturers, yet the fact that it is for such persons a species of proprietory knowledge renders it difficult or unwise for them to make it public, and for these reasons the literature of engineering contains very little published material on these questions. Tests of three bicycles of different grades gave respectively 92, 82 and 72 per cent efficiency considered as machines.

A long series of tests were made with the same large sprocket with seven, eight and nine tooth sprockets on the rear, and with pedal weights varying from two to fifty pounds.

The average efficiencies in each case were as follows:

7 tooth, 89.7.....8 tooth, 91.5..... .9 tooth, 93.4

This shows the 8 tooth to have 98.9 per cent. of the efficiency of the 9 tooth, and the 7 tooth to have 96 per cent. of the efficiency of the 9 tooth sprocket, other conditions being equal.

In actual service, however, the largest rear sprocket which the required gear ratio will allow, is to be preferred, from its better wearing qualities due to the smaller chain pressure upon the teeth.

BASEMENT FLOORS FOR MACHINE SHOPS.

Prof. Jno. E. Sweet—To fix one's ideas in treating this topic, let it be assumed that the ground to be floored is both solid and damp.

With the solid ground only such a depth of filling is necessary as that required to distribute a concentrated load over a large enough area, so that a hole will not be punched through what constitutes the floor. Concrete, if of the best quality, may be as good as anything, and the necessary thickness would depend on the weight of the loads which it has to support. In the writer's opinion a layer of thin flat stone, or two layers, bedded in concrete, and then a thin coating of concrete to give the full depth of say six inches, is better than six inches of concrete, however good.

To cut off the moisture which is to be expected a coat of asphalt is best. Quick lime would be effectual, but with an unmatched floor the lime would sift through the cracks. The writer believes that a layer of two inch plank is better than scantlings buried in the cement, as it better distributes the load, and joints in the top floor can come anywhere. We have determined by experience that the expected in this case does not happen; the floor does not spring up and down. The top floorng is best of only ⅞ inch stuff, 5½ inches or less in width. When the thin top floor is worn through in places and needs repairing, the hole or depression is only ⅞ inch deep, whereas with thicker top flooring it is deeper.

Were we again to lay a floor we would cut all the top flooring into four lengths to facilitate repairing, breaking joints every course.

At the works of John Lang & Son, of Johnstone, Scotland, their shop floor is wholly of iron chips, and is a solid, fairly good floor. Not as clean as a wood floor, but one that would answer well in a basement. The cost of such a floor would depend on the market value of chips. It is cheap to put down and the night watchman can keep it in repair.

---

* Of the A. S. M. E.

† Mechanical Engineering of Power Plants. F. R. Hutton. 1897.

IS PROSPERITY REALLY COMING?

WHAT MACHINERY MANUFACTURERS AND DEALERS IN DIFFERENT PARTS OF THE COUNTRY SAY.

NEW ENGLAND.

From present indications our business bids fair to improve rapidly within the next few months. Our inquiries at present are not only more numerous, but are much more to the point, and have a certain ring about them of better feeling than they have had for a number of months past. Several of the railroads have been ordering machines, requisitions for which have been pigeon-holed for some time.

JONES & LAMSON MACHINE CO.,
Springfield, Vt.

We think there is a little improvement in the sale of machine tools in America. We have all we can do for several months ahead but chiefly for export. FLATHER & CO.,
Nashua, N. H.

We think we notice an improvement in business of late. HAYES TOOL CO., *Portland, Me.*

The outlook for fall and winter business is favorable. There has been some improvement in orders lately. TRIMONT MFG. CO., *Roxbury.*

There has been an increase of orders in the last few weeks and we have also had more inquiries. We consider the prospect bright for future business. THE BATES MACHINE CO.,
Boston.

Inquiries for goods in our Western Dept. have increased considerably within the last three or four weeks; orders are also somewhat more plentiful.

CROSBY STEAM GAGE & VALVE CO., *Boston.*

The volume of our business has largely increased in the past few weeks. We think the outlook for fall and winter business very good.

THE BALL-BEARING CO., *Boston.*

We anticipated very little business during the months of July and August, but have been agreeably disappointed, and business is at least twenty-five per cent. better than we expected. HILL, CLARKE & CO., *Boston.*

It is our opinion that there will be a steady but slow increase in business as judged from the talk of our customers. There seems to be a better feeling in the trade, but the increase has hardly commenced to show itself yet.

CHANDLER & FARQUHAR, *Boston.*

Business has been very much better with us since June 1st and has steadily increased in volume since that time. We have, since the 1st of June, been running full time in all departments on orders and are at the present time employing about 500 hands. We have believed for more than a year that business would be decidedly better before the 1st of January, '98, but we had not expected that we should get so large a volume during the hot summer months. It is unusual and only goes to show that the amount of business is decidedly larger. As our sales are made to almost every kind of industry, as well as to public buildings, works, etc., and cover almost the entire world, we can feel the pulse of business almost everywhere. B. F. STURTEVANT CO., *Boston.*

We have noticed a decided improvement and think we will have a good fall and winter business. AMERICAN TOOL & MACHINE CO.,
Boston.

The outlook for our business is about the same. We are having all we can do and more calls for home trade.

W. C. YOUNG MFG. CO., *Worcester, Mass.*

We have seen no marked improvement of late in orders or inquiries, but we consider the general outlook is very favorable for a slight increase in business.

THE POWELL PLANER CO., *Worcester, Mass.*

Judging from the inquiries for machine tools, we consider the outlook for fall and winter business very good. PRENTICE BROS.,
Worcester, Mass.

The outlook in our business is brighter than it has been for some time, and we think it will be quite brisk this fall and winter. We have quite a number of orders for machines for the home trade. P. BLAISDELL & CO.
Worcester, Mass.

If we were to judge from the papers, we should say that business was booming, but from our own knowledge we cannot say that there has been, nor can we see any material improvement in the near future.

BOYNTON & PLUMMER, *Worcester, Mass.*

Notwithstanding August is a dull month, we are receiving increased orders for tools and cutters, which indicates that manufacturers are starting up. Outlook for fall trade is excellent. THE L. S. STARRETT CO.,
Athol, Mass.

It is early yet in our business to predict what fall trade will be, but with a large wheat crop which promises to sell at renumerative prices, we think the prospect good.

ATHOL MACHINE CO., *Athol, Mass.*

We firmly believe that we shall show a largely increased business this fall and winter over last year. Reports of salesmen are most favorable. WELLS BROS & CO.,
Greenfield, Mass.

There is a much better feeling in all lines of manufacturing. We find that people now take an interest and have good courage; we anticipate a good business in all lines early in September. FITCHBURG MACHINE WORKS,
Fitchburg, Mass.

As we have been busy since the first of January and orders continue to come in, we can say that the outlook is good.

BAUSH & HARRIS MACHINE TOOL CO.,
Springfield, Mass.

There has been a distinct improvement in business and the indications now are for a large fall and winter business.

BEMIS & CALL HARDWARE & TOOL CO.,
Springfield, Mass.

There has been an improvement lately in both orders and inquiries. FIFIELD TOOL CO.,
Lowell, Mass.

Present indications point to increased trade in our line of manufacture during the coming fall and winter. Have been very busy, however, all through the general depression.

CHAPMAN VALVE MFG. CO.,
Indian Orchard, Mass.

We believe the outlook for the fall and winter business is good. Our inquiries lately have been more numerous and we have booked some orders. We feel considerably encouraged. BEAMAN & SMITH,
Providence, R. I.

The fact that we are running our works to their full capacity, that frequently over-time is required to get out our increased business, and that we are receiving a larger number of inquiries than ever before, leads us to think that the wave of prosperity is returning.

MOSSBERG & GRANVILLE MFG. CO.,
Providence, R. I.

If numerous inquiries for prices and the placing of a large number of small orders are indications for a fall and winter business, we have them. NICHOLSON FILE CO.,
Providence, R. I.

While there is no great increase in the number of inquiries, those which we do have mean business and the percentage of orders to inquiries is high. This refers to domestic business. Foreign business is improving all the time. DIAMOND MACHINE CO., *Providence, R.I.*

Prospects for improvement in business seem to us very promising. Inquiries are more active than they have been for some time, and we are running a portion of our works sixteen hours per day. THE BILLINGS & SPENCER CO.,
Hartford, Conn.

Bountiful crops and the settlement of the tariff question should make an improvement in all manufacturing industries this fall. Up to date have noticed no recent improvement in orders. A. D. QUINT, *Hartford, Conn.*

We consider the outlook for fall and winter business very good. We have been obliged to increase our plant to enable us to take care of orders received during the past few weeks.

THE WHITNEY MFG. CO., *Hartford, Conn.*

The opinion of officers of this company that business will increase considerably during the coming fall, is based more upon the general feeling that way than upon a slightly noticeable improvement in inquiry.

THE PRATT & WHITNEY CO., *Hartford, Conn.*

We think the outlook for business is considerably brighter; people are talking and feeling better about the future, and we think business will improve from now on.

NEW HAVEN MFG. CO., *New Haven, Conn.*

We believe confidence is fully restored. Business is already improving with us, and we consider the outlook very favorable for a steady, healthy increase in trade.

THE HOGGSON & PETTIS MFG. CO.,
New Haven, Conn.

The volume of our business has been less than normal for the past five months. This being our dull season it is too early to judge the future from present trade. All outside indications, however, point toward improvement. THE EASTERN MACHINERY CO.,
New Haven, Conn.

Though but little improvement in the number of orders has been noticed, we believe the outlook is favorable to increased fall and winter business. THE SKINNER CHUCK CO.,
New Britain, Conn.

For the past three years our export business has kept us very busy, but at the present time it shows some falling off, although we still have a good number of orders on hand. In regard to the domestic trade, we have not found it very satisfactory as yet, although it shows a very little improvement over a year ago. THE HENDEY MACHINE CO.,
Torrington, Conn.

We are gratified at being able to report improvement in business the past ten days, and increasing demand for machinery for manufacturing sheet metal goods.

THE WATERBURY FARREL FOUNDRY &
MACHINE CO., *Waterbury, Conn.*

Orders and inquiries from our own country are more numerous with us daily, and we anticipate a steadily increasing business from now on. GEOMETRIC DRILL CO.,
Westville, Conn.

There is evidently a better feeling in mechanical circles, and more confidence, but it has not yet materialized in the shape of increased home orders.

BRAINARD MILLING MACHINE CO.,
Hyde Park, Mass.

Outlook for fall business encouraging. Marked improvement by way of orders. Our works are running full time; this on account of orders. PUTNAM MACHINE CO.,
Fitchburg, Mass.

MIDDLE ATLANTIC STATES.

The outlook for business appears to us much brighter than for some time in the past. Inquiries have a firmer tone, and orders are being placed more rapidly.

THE STILES & FLADD PRESS CO.,
Watertown, N. Y.

Our summer business is the most satisfactory for several years and the class of inquiries we are now receiving indicate a good trade for autumn and winter.

THE SENECA FALLS MFG. CO.,
Seneca Falls, N. Y.

Our business from January 1st to July 1st, 1897, was nearly up to the 1892 and 1893 mark. This is now our dull season, and is not a fair index of what we expect for our fall and winter trade. The outlook is good, and there is no reason why we should not do better even than previous to the late depression.

THE FRANK H. CLEMENT CO., *Rochester, N. Y.*

The past six weeks show a marked increase in the demand for our tools. There is every indication of a most satisfactory business in our line for the fall and winter months if our correspondence is any indication.

STOW MFG. CO., *Binghamton, N. Y.*

The outlook for fall and winter business is very much improved. We are not only receiving more inquiries, but more and larger orders. ARCADE FILE WORKS, *New York.*

Our orders and collections show that the long promised increase of business is here beyond question. JOSEPH DIXON CRUCIBLE CO.,
Jersey City, N. J.

We think there is a good outlook for fall trade in our line, both home and foreign.

GOULD & EBERHARDT, *Newark, N. J.*

We have noticed but a slight increase in inquiries, but we have ourselves been extremely busy filling orders for presses and dies, a larger part of which have been for bicycle factories, electrical work and coinage of money. Much of this has been for export, chiefly to Europe and Asia.

FERRACUTE MACHINE CO, *Bridgeton, N. J.*

Of late there has been no perceptible improvement in our business—in fact the sales have dropped off a little in the last two months. We are inclined, however, to think that this is due more to the season of the year than the state of the times.

THE JOHN M. ROGERS,
BOAT, GAUGE & DRILL WORKS,
Gloucester City, N. J.

The indications are particularly good with us just now as we are running our shops day and night and are especially busy on stocking machinery. TRUMP BROS. MACHINE CO.,
Wilmington, Del.

The outlook for fall and winter trade is good. We have noticed quite a decided improvement in business. Have numerous orders in hand. Are running full time and almost full-handed. BETTS MACHINE CO., *Wilmington, Del.*

We consider the outlook for fall and winter business very good. We have noticed quite an improvement lately both in inquiries and orders. MORTON, REED & CO., *Baltimore.*

While we have not noticed any particular improvement of late either in inquiries or orders, we anticipate more favorable conditions in the late fall and winter than prevailed last year. HARRISON SAFETY BOILER WORKS, *Philadelphia.*

We are anticipating a fair business during the coming fall and winter. Are receiving inquiries and making quotations daily on the various lines of textile machinery we manufacture; in fact, our department for manufacturing cards, garnets, feeders and power transmission machinery have about all they can do. JAMES SMITH WOOLEN MACHINERY CO., *Philadelphia.*

Inquiries for fall business are coming in freely, with a fair prospect of numerous orders to follow. MARIS BROS., *Philadelphia.*

The outlook is bright and all signs point to returning prosperity from now on. MORSE, WILLIAMS & CO., *Philadelphia.*

In our opinion business is slowly but steadily improving in amount. Prices are still too low, owing to competition that is little better than insanity. BEMENT, MILES & CO., *Philadelphia.*

The outlook for fall and winter business is very good and we have noticed a very considerable improvement in small orders. GEO. V. CRESSON CO., *Philadelphia.*

We feel very confident of a speedy revival. We have numerous substantial inquiries and we have received more orders in the last two weeks than any two months in a year or more. NEWTON MACHINE TOOL WORKS (INCORP.) *Philadelphia.*

Our views of the future are that we will be somewhat slow in reaching sufficient volume to enable prices to expand, to what they should be. The prices of every thing that need to be assembled to make a ton of pig iron are, in a number of cases, below the cost of production. The rates of freight to assemble the pig iron have been extremely low, and it is only this that has enabled the pig iron to compete with the ruling low market price. Taking everything into consideration, there should be a very heavy demand and increase in price for pig iron during the month of August and the coming year. L. & R. WISTER & CO., *Philadelphia.*

In our opinion the general outlook for fall and winter business is growing brighter daily. The volume of orders is increasing and we feel that by the end of August our facilities will be crowded to their utmost. BETHLEHEM FOUNDRY & MACHINE CO., *South Bethlehem, Pa.*

Business is certainly looking better than it has for a long time, and the prospects for a good fall trade were never more favorable. U. BAIRD MACHINERY CO., *Pittsburg, Pa.*

To us the outlook for fall and winter business is very promising, there being a healthier, firmer tone to our trade. THE SCRANTON SUPPLY & MACHINERY CO., *Scranton, Pa.*

The business outlook is improving, and there is a decided increase in orders and inquiries. PHŒNIX IRON WORKS CO., *Meadville, Pa.*

WESTERN STATES.

We notice marked improvement in machine trade, last month bringing us the largest July business on automatic screw machines in the history of our company. We are making necessary changes throughout our factory to largely increase our steel ball output for the coming season, anticipating a healthy increase in the trade. Orders now booked and inquiries being received indicate a marked increase in demand for all sizes of steel balls. Throughout the past season we had to run our factories 22 hours per day in order to fill orders promptly, hence the necessity for increasing our facilities to be in a position to meet the increased trade. THE CLEVELAND MACHINE SCREW CO., *Cleveland, O.*

From present inquiries the outlook for fall and winter business is very bright. BARDONS & OLIVER, *Cleveland, O.*

We are quite satisfied with present business we are doing and future prospects in sight. THE ACME MACHINERY CO., *Cleveland, O.*

The reports we have from our traveling salesmen and all indications point to a good fall business in this section. THE MCINTOSH HUNTINGTON CO., *Cleveland, O.*

We notice a steady increase in both inquiries and mail orders, and our traveling men not only report a better feeling, but are getting more orders than heretofore. We believe that the worst is over and that permanent improvement has begun. THE RELIANCE GAUGE CO., *Cleveland, O.*

The general impression in this vicinity is that business is on the eve of a vast improvement over what it has been since '93, but owing to the coal strike, matters are very quiet; as soon as this is settled we believe there will be very much more business. S. M. YORK, *Cleveland, O.*

We beg to state that while we do not yet notice a very marked improvement in business, the tone of our inquiries and orders is such as to warrant us in expressing the belief that there will be a decided improvement in the near future. THE BRIGHTMAN MACHINE CO., *Cleveland, O.*

We have noticed a decided improvement in orders from hardware and supply houses since the first of the month, and we look for a continuance of good business during the present year. THE STANDARD TOOL CO., *Cleveland, O.*

Railroad shops, manufacturers of agricultural machinery and iron industries of every description in the central and Western States are busy. Five thousand men have been put to work in this city since August 1st. The last twenty days we have booked more orders than for the same number of days any time during the past two years. The business outlook for fall is most promising. CLEVELAND TWIST DRILL CO., *Cleveland, O.*

The improvement here is very noticeable. Old concerns are increasing their force, and several new enterprises are getting under way. Both inquiries and orders show marked increase. THE STRONG, CARLISLE & TURNEY CO., *Cleveland, O.*

Orders have been coming in from all over very well of late, more so than usual for August, especially from the West and Southwest. Inquiries from everywhere, Canada included, indicate good business ahead for this fall and winter. THE HART MFG. CO., *Cleveland, O.*

The fall and winter business with us is looking very well indeed. At present business is improving considerably over last year's business, up to date. There has been quite an improvement in the inquiries for orders over the past three or four years. THE GARRY IRON & STEEL ROOFING CO., *Cleveland, O.*

THE volume of business so far this year has been nearly equal to that of a year ago, which was the best we have had. We think there is reason for believing that the American trade will be better than for some time past. WARNER & SWASEY, *Cleveland, O.*

The first six months of this year were exceptionally good ones, a large part of our orders being foreign. We are at present not receiving as many orders for export, but we are disposed to think that home trade is beginning to look up somewhat. SEBASTIAN LATHE CO., *Cincinnati, O.*

While at present quite full of work, it is for machinery that is used for season business, which we cannot expect any more of this year, or until next spring. We are quite hopeful, but there are no special indications at present upon which we can base any assurances. THE LANE & BODLEY CO., *Cincinnati, O.*

Business at present is very satisfactory. While we note no recent material increase, yet anticipate a further improvement this fall both at home and abroad. JOHN STEPTOE & CO., *Cincinnati, O.*

We believe that the fall and winter business will show a marked improvement over the early part of the year in this country. We base our opinion upon the increased number of inquiries and orders that we received in the past thirty days. THE CINCINNATI MILLING MACHINE CO., *Cincinnati.*

Judging from the number of inquiries and orders received during the latter part of July and the first part of August up to the present time, the outlook for fall and winter business is very promising. MM. E. GANG & CO., *Cincinnati.*

Business has greatly improved with us and we are working with double the force we had last year, and we have orders enough on hand to keep us busy for the next three months and still they come in at a very lively rate. There is no doubt but that we will have an excellent business in the fall and it is our intention to increase the price of our goods at least 10 per cent. DIETZ, SCHUMACHER & BOYE., *Cincinnati.*

Domestic business has greatly improved. We think prospects are for a steady and solid improvement from now on. THE LODGE & SHIPLEY MACHINE TOOL CO., *Cincinnati.*

The outlook now is brighter than at any time since 1892. A decided improvement is manifested, both by increased orders and inquiries. THE E. A. KINSEY CO., *Cincinnati.*

We do not remember when, in the past two or three years, we have felt so much encouraged as we do just now. Orders have been abundant, from both at home and abroad, and continue to come in nicely. BICKFORD DRILL & TOOL CO., *Cincinnati.*

We have found a decided improvement in business since July 1st. We are receiving liberal orders and inquiries are good. The outlook for the fall and winter business is good. THE BRADFORD MILL CO., *Cincinnati.*

At no time in the history of the business have we seen as fair prospects for good business as we now see for the near future. While we are not at this moment "snowed under" with orders, we see enough ahead to justify us in planning on a larger scale than ever. THE PATTERSON TOOL & SUPPLY CO., *Dayton, O.*

The prospects of better times are good. We have been very busy for the last four months, and foreign and domestic orders are increasing steadily. DRESES, MUELLER & CO., *Cincinnati*

We regard the business outlook as very favorable. Inquiries have materially increased and orders are fairly good. There is every indication of a largely increased business in the near future. THE NILES TOOL WORKS CO., *Hamilton, O.*

We have yours of the 11th, and in reply will say that the outlook is not good just now, but we think there will be a change for the better this fall, as inquiries for machinery are a little more numerous than they were. THE LONG & ALLSTATTER CO., *Hamilton, O.*

The prospect for fall trade with us is quite promising. Orders have come in much more freely in the last month. BAKER BROS., *Toledo, O.*

A decided improvement. Every mail brings inquiries. The outlook is very bright. THE TOLEDO MACHINE & TOOL CO., *Toledo, O.*

The orders we have received lately are larger than for years for both new and recut files. Collections easier, and a great many inquiries. REYNOLDS BROS., *Columbus, O.*

The business outlook very encouraging. Judging from the orders and inquiries which we are receiving, it is a clear indication that there is a general awakening in all industries. THE JEFFREY MFG. CO., *Columbus, O.*

We have not closed down or reduced our force during the depression of the last year or two, and at present find business exceptionally good, with a prospect of its continuing so, and are now running extra time in order to keep up with our orders. THE KILBOURNE & JACOBS MFG. CO., *Columbus, O.*

We look forward to a very good business. We can scarcely expect our business to improve, in as much as our foreign business has been very heavy, and whether it will continue to be that way during the rest of the year or not, remains to be seen. Our home trade shows decided improvement. THE SPRINGFIELD MACHINE TOOL CO., *Springfield, O.*

While spring and summer trade with us has been excellent, it is at the present time rather quiet; with improved business conditions throughout the country, we anticipate a brisk fall and winter trade. WEBSTER & PERKS TOOL CO., *Springfield, O.*

Since the new tariff bill has gone into effect and the excellent prospects for large crops, we cannot but feel that we will have more orders than we can take care of during the fall and winter. Business has already revived and is improving every day. We are running a full force of men and feel very much encouraged indeed at the outlook. THE DEFIANCE MACHINE WORKS, *Defiance, O.*

Business prospects with us look decidedly better than they have for several years, as we are very busy, working nights partof the time. Home trade and inquiries are improving, owing to bountiful crops and good prices. We are also enjoying a fine foreign business.
THE OHIO MACHINE TOOL CO., *Kenton, O.*

We are extremely busy at present, running our factory (23) hours per day with double force, and from appearances, orders and inquiries being received more numerously than for some time past. It is very likely we will require to increase the capacity of our plant with additional buildings and machinery.
THE NATIONAL MACHINERY CO., *Tiffin, O.*

We think the improvement in inquiries and orders quite noticeable, and anticipate a good fall and winter business.
THE A. P. WAGNER TOOL WORKS, *Sidney, O.*

We are filled up with orders; working overtime. Inquiries assure us a good fall and winter business.
THE MIDDLETON MACHINE CO., *Middleton, O.*

The prospect is very encouraging. While there has been no boom in our line, we have had a gratifying increase in both inquiries and orders of late and are satisfied there is a material improvement in the business situation, as increased purchasing by railroad companies is a pretty sure index of a general revival of the business of the country at large.
M. M. BUCK MFG. CO., *St. Louis.*

Trade for the coming fall and winter will exceed last year by 50 per cent. Crops are larger, prices higher, debts smaller, than for years; the difference is spent for goods.
N. O. NELSON MFG. CO., *St. Louis.*

Owing to the general opinion in the spring that the wheat crop in this section of the country would not average over 25 to 30 per cent, there were no new flour mills built nor old ones repaired, which will effect this year's business. In shafting, pulleys and general machinery, the demand is improving daily. Competition is great and profits small, but we look forward to a fairly good business this fall and winter.
TODDS & STANLEY MILL FURNISHING CO.
St. Louis.

We think business seems to be improving, slowly but surely. Orders for machinery are being placed and more inquiries are being received. GISHOLT MACHINE CO., *Madison, Wis.*

We are receiving a decided increase in number of inquiries and orders; our prospects for fall and winter business are good.
KEMPSMITH MACHINE TOOL CO., *Milwaukee.*

Prospects much brighter—more inquiries. The great harvest bound to have good effect. The passage of tariff bill will also give indirect excuse to adjust any prices that have been too low during the last year or two. Collections good. H. D. EDWARDS & CO., *Detroit.*

We consider the prospects for our fall and winter trade as good. We have felt a gradual improvement in our business since the 1st of June last. LELAND & FAULCONER MFG. CO.,
Detroit.

Our business has been getting better (season considered) for the past two or three months. Future prospects good owing to our two catalogs, "Book of Tools" and Wood-Workers' Tools," and the settlement of tariff question.
CHAS. A. STRELINGER & CO., *Detroit.*

We have noticed a marked improvement in orders during the last sixty days. Our business for July was the largest of any single month since we began business eleven years ago, and the outlook in our line we consider to be good. PENBERTHY INJECTOR CO., *Detroit.*

Our trade for July was 50 per cent. larger than last year, and we look for a correspond ing improvement during the fall and winter
SAGINAW MFG. CO., *Saginaw, Mich*

While we do not look for a large rush of business, we believe from orders that are coming in that the fall trade is going to be fair. Our mail orders for the past month are in advance of any previous July for three years past. THE FOX MACHINE CO.,
Grand Rapids, Mich.

Our business for the past six months has been decidedly better than for the preceding six months. Just now there is the usual midsummer falling-off of orders. In a recent extended business trip, we found that many shops were extremely busy, and many others extremely dull. We are unable to prophesy as to the future.
MITTS & MERRILL, *Saginaw, Mich.*

We believe the outlook for fall and winter business in America is very bright. The sharp advance in farm products of all kinds, and the starting up of idle factories in all parts of the country, with the tariff matter settled, must bring better times.
THE BATTLE CREEK STEAM PUMP CO.,
Battle Creek, Mich.

The outlook is bright. Have a number of inquiries and have recently booked orders for drop hammers and large presses. Prosperity is with us.
WOOLLEY FOUNDRY & MACHINE WORKS,
Anderson, Ind.

Our business for the past few months has been very satisfactory as to the number of machines sold, although prices as a rule have been low. We are receiving an increased number of inquiries from all sections of the country. J. B. DOAN & CO., *Chicago.*

Our business has been very good since the first of the year, and from the inquiries we are now getting, the outlook for a good fall trade is very promising.
MCDOWELL, STOCKER & CO., *Chicago.*

Inquiries are better and orders are more frequent since last February than any time since May, 1893, and the continual gradual increase of both inquiries and orders lead us to think that we will be doing our normal business by the last of this year, or next spring at the latest. HILL, CLARKE & CO., *Chicago.*

We are encouraged with the prospect for business. We have had more inquiries within the last thirty days than for the entire six months past, and our actual orders within that time have been satisfactory.
THE Q AND C COMPANY, *Chicago.*

Inquiries in our line have been better the last ten days, but we do not look for much business before the first of the new year.
DAWSON & GOODWIN, *Chicago.*

We are pleased to be able to report a decided improvement in business, both present and prospective. The rapidly increasing foreign demand for our tools is especially gratifying. ARMSTRONG BROS. TOOL CO.,
Chicago.

We have noticed a marked improvement in our regular line of drills and bicycle machinery within the last week or so, but because of our special machines and foreign trade we have been constantly from six to ten weeks behind with orders ever since a year ago last July. Prospects with us are bright.
STOVER NOVELTY WORKS, *Freeport, Ill*

The outlook for business is encouraging.
THE INGERSOLL MILLING MACHINE CO.,
Rockford, Ill.

Sales to August 15th this year are within 21 per cent. of entire sales for month of August last year. Sales for month of July this year exceeded those for same month of last year by 62 per cent. Are receiving substantial inquiries and look for favorable winter business. BIGNALL & KEELER MFG. CO.,
Edwardsville, Ill.

We find our customers quite busy. They offer considerable encouragement for orders for additional equipments soon. Future looks much brighter. O. L. PACKARD MACHINERY CO.
Milwaukee.

Our shops are fairly busy, and we consider the outlook encouraging. We are receiving about the customary number of orders and have our usual force employed.
THE EDWARD P. ALLIS CO., *Milwaukee.*

SOUTHERN STATES.

All conditions in the South are favorable for a good business from now on, though July and August were not up to our expectations; still there is an undertone of confidence and strength. SMITH-COURTNEY CO., *Richmond, Va.*

We are quite full of work now, repairing ginning and oil mill plants for the season's work. Crop prospects seem to be good. This is our busiest season of the year.
LOMBARD IRON WORKS & SUPPLY CO.,
Augusta, Ga.

Replying to your request, we find inquiries increasing and many small orders coming in. We think that when crops commence to move heavily, business will improve in every branch.
NEW ORLEANS RAILWAY & MILL SUPPLY CO.,
New Orleans, La.

Business is not improving so far as we are able to judge from our own experience and that of our numerous customers.
THE BUCHEL MACHINE WORKS,
New Orleans. La.

PACIFIC COAST.

Large crops and good prices for the agricultural interests—increasing demand and better prices for lumber interests, combine to make conditions favorable for largely increased business during the coming fall and winter. Only slight improvement noticeable as yet.
J. M. ARTHUR & CO., *Portland, Oregon.*

There is no improvement in inquiries or orders, on the contrary the machinery business is worse than at any time in 21 years.
TATUM & BOWEN, *Portland, Oregon.*

We observe a perceptible increase in the demand for machinery, and regard the business outlook in California to be very promising indeed. PARKE & LACY CO., *San Francisco, Cal.*

ROLLER-BEARING DATA.

In a paper read before the British Institution of Civil Engineers on the subject of roller bearings by Mr. Marshall, he says:

"The following are the results of careful experiments made to ascertain the relative starting effort and running friction of tramcars fitted with ordinary and roller bearings.

Starting effort.—Cars weighing 4 tons 15 cwt.; ordinary bearings, 198 pounds, or 41.68 pounds per ton; roller bearings, 30 pounds, or 6.53 pounds per ton.

Running Friction.—Gravity test.

A car fitted with ordinary bearings and weighing 2 tons 15 cwt. was let loose from a point 56 feet up an incline with 1 foot 6¼ inches rise. It ran down this incline and 57 feet along the level at foot of same, or a total distance of 111 feet. The force expended was, therefore, 6 160 pounds falling through 1.521 feet, or 9 364 foot-pounds. The average frictional resistance was 9364 ÷ 111, or 84 pounds, equal to 30.5 pounds per ton. A similar car fitted with roller bearings, being let loose from the same point, ran the full length of the level line available—namely, 320 feet—and had not then quite come to rest, the total distance traversed being 376 feet. The force expended was as above, 9364 foot-pounds. The average frictional resistance was 9364 ÷ 376, or 29.4 pounds, or about 9 pounds per ton of load."

In this connection the following table regarding the material, pressures and speeds suitable for roller bearings, represents the practice of the Mossberg & Granville Co., of Providence, R. I.

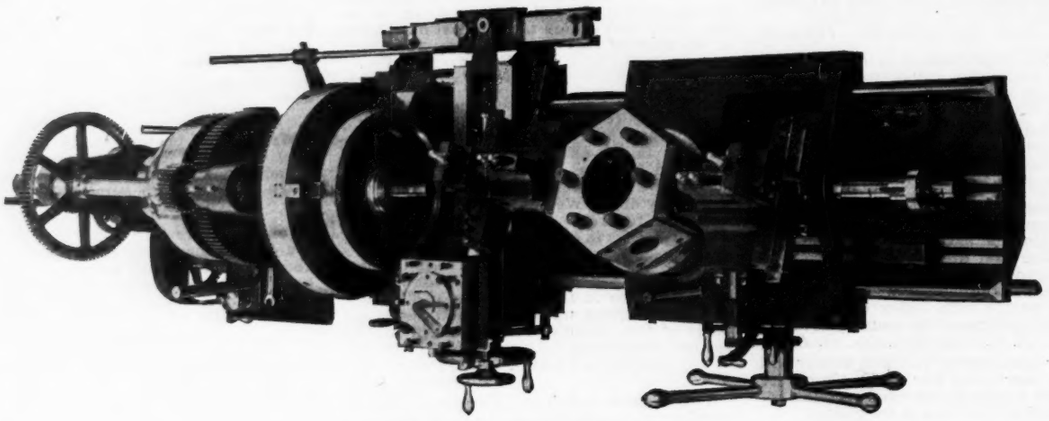
Rolls.	Journal and Box.	Pressure, lbs. per square inch.	Speeds. (Revolutions).
Tool steel, hardened.....	Hard	20 000	0 — 50
	"	8 000	50 — 200
	"	6 000	200 — 500
Drill rod, soft.....	Machine steel	75	0 — 300
	Cast iron	40	0 — 100

Mr. Marshall summarizes the requirements of satisfactory roller bearings as follows:

1. That the proportions of their parts, and the materials of which they are constructed, are suitable to withstand the stresses imposed upon them. 2. That the bearing rollers must be kept parallel with their axle, or journal, and that they must not be allowed to touch each other. 3. That the bearings must be simple, and contain as few working parts as possible, and that they must be so designed that they can be applied and adjusted by any intelligent workman. 4. That they can be produced at reasonable cost. Simple as these requirements may appear, it is probable that only those who have tried to construct such bearings know how difficult they are to obtain.

A GISHOLT LATHE, FINISHING GEAR BLANKS.

The accompaning illustration gives a view of a Gisholt turret lathe in the process of finishing a gear blank. As it is taken from above and looking down upon the lathe, it shows the general arrangement of the tools to much better advantage than the ordinary photograph, and presents an interesting example of what may be called the modern method of doing cast-iron lathe work



A GISHOLT LATHE, FINISHING GEAR BLANKS.

The process of finishing a gear blank is as follows, it being understood, of course, that a number of pieces are operated upon before changing the tools for another operation:—

In the first operation the blank is chucked by inside of rim, and the hole is bored with boring bars having double end cutters and supported at outer end by a bushing in the chuck. The roughing facing head is brought into position, and the rim and hub faced with wide shaving cutters, and the hub turned, the facing head being steadied by a supporting arbor fitting the bore of the blank. The second facing head is then brought into position for finishing.

As the blank is of quite large diameter, the rim is roughed out and finished with tools in the turret tool post, making each setting with micrometer adjustment on cross feed screw. This completes the first operation.

In the second operation the blank is mounted on the face plate arbor, held by taper bushing in the chuck, and is driven by soft jaws which are screwed down on to the rim. The soft jaws are bored to the same diameter as the blanks, so as to give plenty of clamping surface.

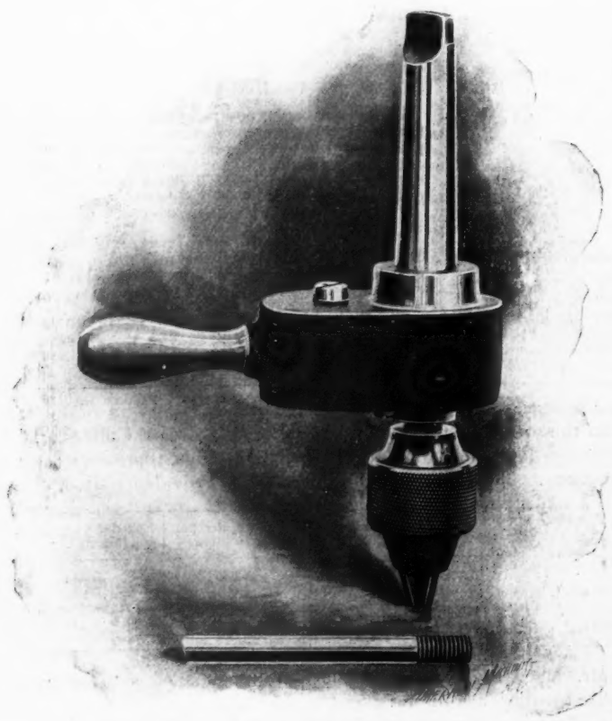
Both sides of this blank are alike, so that no change is necessary in the facing head cutters, from the setting in the first operation. The supporting arbor is removed from each head and a proper face plate arbor bushing inserted in its place. The facing heads are then brought up and the blank roughed and then finished as in the first operation, steadying each facing head in turn with face plate arbor. This completes the second operation.

These blanks are made by The Gisholt Machine Co., Madison, Wisconsin, U. S. A.

* * *

A HIGH SPEED DRILLING ATTACHMENT.

We illustrate herewith a high-speed drilling attachment designed for use in any drill press. It often happens that oil-holes, or other small holes, have to be drilled in work, which, because of its size, or for other reasons, must be drilled under a large drill press. As these machines are seldom speeded up sufficiently for small size drills, a good deal of time is lost. One of the chief uses of this attachment, therefore, would be in cases of this kind.



HIGH-SPEED DRILLING ATTACHMENT.

The device consists essentially of a casing, containing four hardened steel gears, one of which is cut directly upon the end of the taper shank projecting through and above the box, another is cut midway in the length of the spindle carrying the drill chuck, the upper end of which spindle fits in the end of the taper shank, while the two remaining gears act merely as the back gears of a lathe, except that in this case they increase, instead of decrease, the speed imparted to the driving gears. To use the attachment, the taper shank is merely inserted in the spindle of a drill press like any ordinary drill, the machine started, and the spindle fed down as usual. For each revolution of the drill press spindle, the attachment spindle makes something over two revolutions.

For small work which is held in the hand while drilling, in an upright drill, the rod shown in the foreground of the cut is screwed into the end of the handle of the attachment, and rests against the frame of the machine to keep the box from revolving with the spindle; but for large work, operated upon under a radial drill, where the work is sufficiently heavy to prevent being revolved by the drill, and it is not essential to have both hands free at all times, this rod is unnecessary, as the merest touch of the finger is sufficient to prevent rotation of the box.

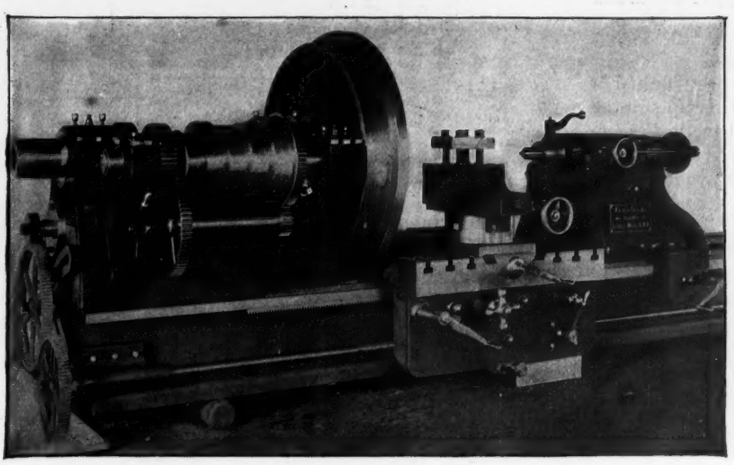
The device is made by the Bickford Drill & Tool Co., Cincinnati, Ohio, who have recently made application for a patent.

* * *

LORD'S POWER MAGAZINE, published at 620 Atlantic avenue, Boston. Mass., has absorbed the *Stationary Engineer*, formerly published at Chicago, and the *Safety Valve*, of New York. It will now be known as the *Engineers' and Power Users' Magazine*. The magazine form and general character of Lord's magazine has been retained.

A LATHE FOR HEAVY WORK.

The Fifield Tool Company, of Lowell, Mass., have recently put a 64-inch lathe on the market, made from entirely new patterns, which is designed for heavy railroad work and is also well adapted to all classes of shop work. To this end it is made very heavy, with large bearing surfaces, and at the same time can be handled easily. The gearing in the headstock also provides for 20 speeds, thus enabling the best results to be obtained on work of varying material or of any diameter that comes within the range of the lathe—a feature that is not always met with in heavy tools.



64-INCH FIFIELD LATHE.

The gearing is arranged so that the main spindle can be driven with an open belt, with back-gears, with open belt through triple-gear and with back-gears and triple-gear, which, with the five steps on the cone gives the 20 changes of speed.

The principle dimensions of the lathe are: Swing over ways, 64 inches, over carriage, 45 inches; diameter front bearing, 14 inches; rear bearing, 12 inches; width of belt, 5 inches; bearing on ways, 66 inches; weight, 36 000 pounds.

* * *

HORIZONTAL TWO-SPINDLE DRILL.

The accompanying illustration is of a machine designed for accurately drilling two holes at once in duplicate pieces, such as conveyor link blocks, for which pieces the machine, as shown in the illustration, is specially fitted.

The driving cone is on a hollow shaft, or sleeve, running in bearings, which take all the shock and strain due to the belt and thus relieve the spindles of excessive wear. The spindles are driven through a shaft which is free to slide in the cone sleeve, but turns with it, both the shaft and sleeve being splined and fitted with a feather. On the outer end of the shaft is a pinion which gears with the two pinions on the drill spindles.

This arrangement allows the usual practice of feeding the work up to the drills to be reversed and the slide which carries the drills is provided with a powerful power feed and a knock-off. The upright lever at the back throws in the power feed, and the hand wheel in front gives the quick return. In drilling the link blocks, three are put on the table at once, one fitting into the other. An oil pump and pan, and countershaft are provided. The machine is manufactured by Foote, Barker & Co., Cleveland, Ohio.

* * *

The index to volume III will be ready September 10 and will be mailed to any reader who wishes a copy, free of expense.

A "WHICH WAY" LEVEL.

E. G. Smith, of Columbia, Pa., the manufacturer of a number of useful tools for machine shop use, has brought out a new level that would make a convenient acquisition to any machinist's kit. It is the size of a dollar, costs a dollar and Mr. Smith says it is well worth it. It is composed of a piece of round glass, ground concave in the center, accurately set in a steel base with a steel cap. The base is marked in the center so that it can be told by sighting when the bubble is central. By placing the level on a piece of work it can be see in at once just which way it is out.

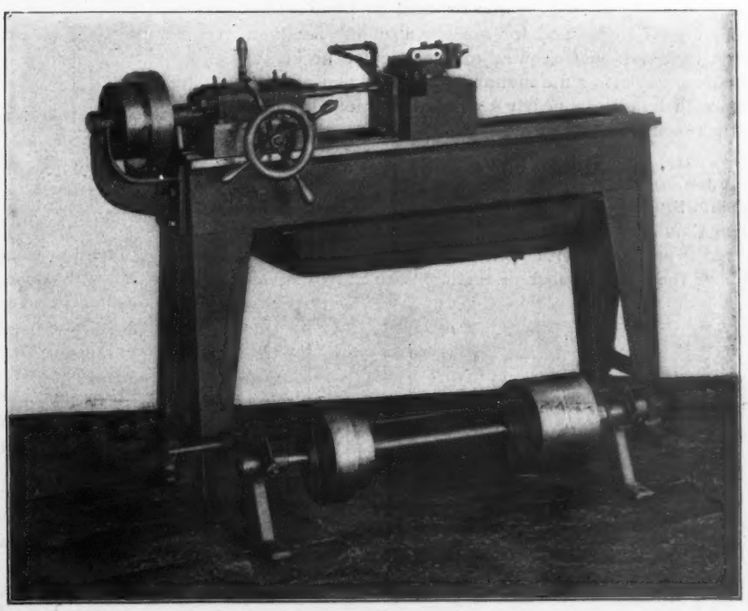
* * *

THE *Canadian Engineer* publishes an illustration of a roller boat, which is being built in a yard at Toronto. It is in the form of a cylinder 110 feet long and 22 feet in diameter, with paddles along the outside. The engine and platform or cabin for passengers will be placed inside this cylinder, the engine running on a track and turning the cylinder just as a squirrel might turn the cylinder in its cage. Mr. Knapp, the designer, believes his new boat will make a speed of a mile a minute.

There is nothing novel in the invention. Roller boats are about as old as rotary engine and not nearly so successful.

The interesting fact in the matter is that M. Knapp is a lawyer. It is amusing, at times, to see how many men become seized with the idea that there is nothing in mechanics, anyway, and that they are going to revolutionize things in that line. It is pitiful, moreover, to look over the patent records and see what is represented there in the way of work and worry, and often suffering, on the part of those who have gone to work to "invent" some mechanical device, without the slightest knowledge of what men trained in that work have accomplished, or what are the principles involved.

Mr. Knapp may be a good lawyer, but his ideas show on the face of them that he is no mechanic. If he were to announce to the medical profession that he proposed to revolutionize the method of amputating legs or curing heart disease, he would be hooted down; but doubtless many will view his boat with a wise look and pronounce it a coming success.



HORIZONTAL TWO-SPINDLE DRILL.

WHAT MECHANICS THINK.

THIS COLUMN IS OPEN FOR THE EXPRESSION OF PRACTICAL IDEAS OF INTEREST, TECHNICAL OR OTHERWISE. WRITE ON ONE SIDE OF THE PAPER ONLY, AND BOIL IT DOWN.

WHEN SKETCHES ARE NECESSARY TO ILLUSTRATE THE IDEA, SEND THEM ALONG—NO MATTER HOW ROUGH THEY MAY BE, WE WILL SEE THAT THEY ARE PROPERLY REPRODUCED.

For the best practical idea sent us each month to use in this column we will send a copy of Usher's "Modern Machinist," or Grimshaw's "Shop Kinks." For the next best we will enter a subscription for one year to MACHINERY to any desired address. For the next best, or for any idea that is worth publishing, we will send a copy of Colvin and Cheney's "Machine Shop Arithmetic."

INFORMATION WANTED.

I am looking for some information as to the best method of blacking steel castings. There are a good many receipts in the mechanical cyclopedias, but none of the practical methods seem to reach such books, and such methods as I have tried do not seem to be satisfactory. I should be glad if any of your readers can give me directions for some process that will accomplish the desired results. F. A. W.

A FEW NOTES.

A STEP CENTER, ETC.

This is a relic of former days, when engine lathes were the only tools used for bolt turning. By its use calipers can be almost entirely dispensed with, as the different sizes are represented by the steps on tail center and by running point of tool up to size wanted, nearly the same diameter will be turned on stock. After

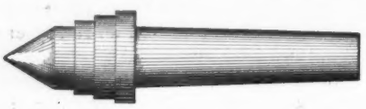


Fig. 1

Fig. 2

a little experience the amount of variation can be allowed for and commercial accuracy attained. Although not much used now, it seems that it would still prove useful on some kinds of work.

Fig. 2 is a hand tool for iron or steel, and is used for rounding off angles and for making a smooth finish on work that does not require any particular accuracy. It is preferable to a file in many cases, and is used on a rest with handle in nearly a vertical position. With a little knack it proves a time saver.

A PROBLEM.

A tool-room lathe, Fig. 3, has a lead screw of eight pitch. Stud D makes one revolution to two of spindle. Gear C on stud can be thrown in mesh with A, which is keyed to spindle or with B, which rotates with belt cone. A and B have the same number of teeth. With 24 tooth gear on screw

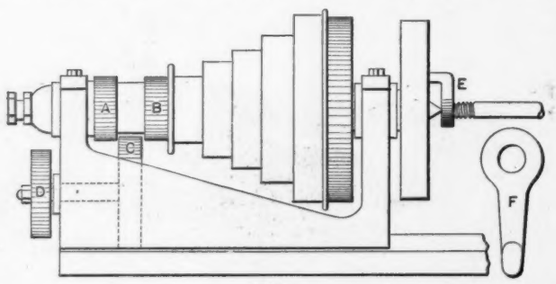


Fig. 3

and 96 tooth gear on stud D, and gear C in mesh with B, back gear being in, a screw of 2¼ pitch can be cut. Wanted, the ratio of back gears and what thread can be cut when C is geared with A.

F and E, in Fig. 3, show a driver for bolts to be used in facing the heads. A number are provided tapped with the standard threads of various sizes in use, care being taken to use only the taper tap and not cut a full thread clear through.

Fig. 4 is a simple internal grinder that can be easily extemporized in almost any shop. The bar H, which carries the emery wheel G and belt pulley J, is mounted on centers as shown; the center on head-stock being adjustable by slide and screw K. The work I is clamped to angle plate fastened to carriage.

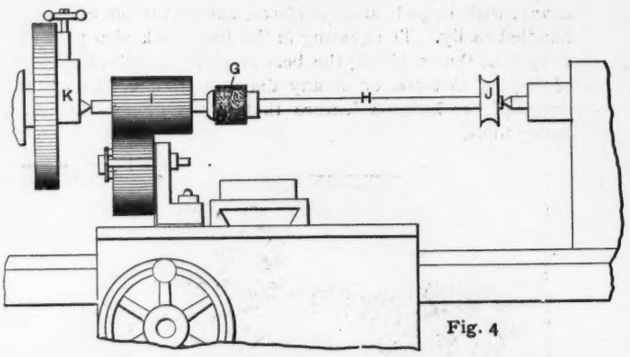


Fig. 4

With lathe in back gear and J belted to separate counter, a planetary motion is given to G dependent on the amount K is moved from center of rotation. This amount is limited, depending on length of bar H; larger wheels being used when limit of movement is reached. The same principle of throwing bar H out of center of rotation can be applied with success to a boring bar; a cutter being used in place of emery wheel and belt pulley being dispensed with. The diameter of circle described by point of cutter is readily controlled by slide K, which is often very desirable. FRED E. ROGERS.

MORE SPLIT PULLEY EVIDENCE.

I was very interested to read in your last issue, the article entitled the "Split Pulley Patent," and perhaps it may interest you to learn, that for the 17 years I have been at the head of these shops, I have never used any keyways to secure the pulleys to the shaft, and for 12 years I have not been using any keys for the fly-wheels of my engines, which I am making in two pieces.

Bruxelles. H. BOLLINCKX.

HANDY WOOD-WORKING DEVICES.

I send herewith sketches of two devices that will often be found convenient. The first is a lathe attachment, shown in Figs. 1 and 2.

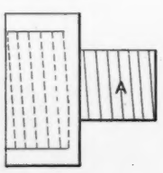


Fig. 1

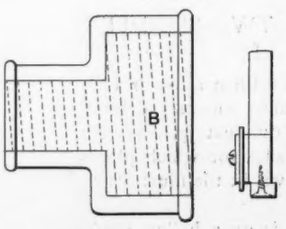


Fig. 2

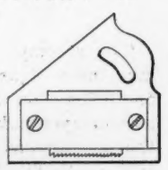


Fig. 3

The first thing to procure is a variety of sizes of pipe-reducers, all with same size at small end—say 1 inch. The large ends should be sizes ranging from 1¼ inch to 4 inches. Make a fitting to fit mandrel nose of lathe, as shown in Fig. 1, with the screw at A to fit the 1-inch thread of pipe-reducers. All the reducers will then fit the lathe. Into the large end of reducers screw or drive blocks of wood, letting them project an inch or more. We have quite often some piece of rough or finished work that we cannot hold in the lathe very easily. Our new device comes into play by turning into the wood a recess of suitable size, or cutting in the same, so that the piece will fit in snugly and can be turned, etc. If necessary, a rod of wood can be placed between tail center and work, or the center itself run against it.

Fig. 3 shows a special saw for rebates that hardly needs any description. By using different thicknesses of saws or cutters different rebates can be cut, and the adjustable piece on the bottom admits of different distances from edge. This device was made originally for rebating for slides in camera plate-holders. It will come handy in a variety of ways, and by making it solid and fastening the saw properly, grooves can be worked in soft brass, etc. F. H. JACKSON.

Angelica, N. Y.

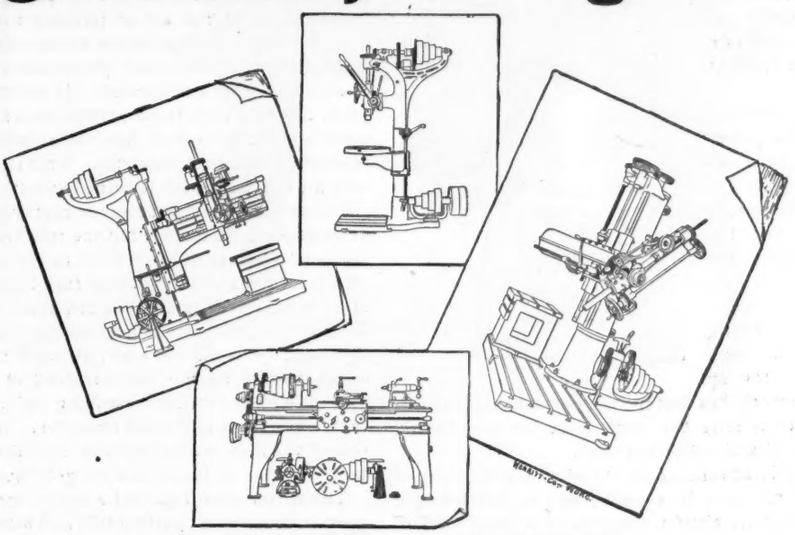
PRENTICE BROS.,

WORCESTER, MASS., U. S. A.

BUILDERS OF

Drilling Machinery and Engine Lathes.

High Grade Machines.



Catalogues Free.

FOREIGN AGENTS:

SCHUCHARDT & SCHUTTE: - - - Berlin, Brussels, Vienna.
CHAS. CHURCHILL & CO., LTD., - - London, Birmingham.
AD. JANSSENS, - - - - - - - - Paris.

Gear Planers,

Automatic, for Bevels only. 12 inch to 48 inch.
Half-Automatic, Bevels and Spurs. 48 inch to 108 inch.

The only way to make gears that are RIGHT and that will run well, is to plane the teeth. This machine does that work quickly and at a small cost. Rotary cutters will not do the work satisfactorily, because they are wrong in principle. Don't guess, cut, try and file any longer. This machine makes a sure thing of it.

24 Inch Automatic Bevel Gear Planer.

Gears

Up to 12 feet Diameter.

Lathes

26 inch to 84 inch Swing.

AGENTS:

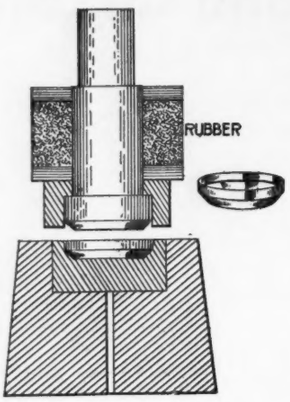
Chas. Churchill & Co., London.
H. Glaenzer & Co., Paris.
Fenwick Freres, Paris.
Schuchardt & Schütte, Berlin.

Gleason Tool Company, Rochester, N. Y., U. S. A.

DROP PRESSES.

Perhaps a few notes on that much abused tool, the "drop-press," may interest some of your readers who are, perchance, users, and also those who think that the chief use of a drop-press is to jam fingers and destroy dies. I admit that a drop-press has no respect for fingers or anything else, but in one make of press that I am familiar with, this danger is wholly averted, and the output of the press is at the same time increased.

I send you a cut showing a die used for doing a class of work not usually included in the list a drop-press is designed for, namely, the drawing up of shells or caps, such as is usually done on a power press. Good results can be obtained on work of this kind, provided the shells are not over 3" or 4" deep, and of a diameter equal to the depth of the same.



The blank, which is previously punched out on the power press, is held in place by a set-edge in the usual manner, and as the hammer comes down, is held from crimping by the blank holder, upon which the pressure is obtained by a rubber spring, which, by compressing, allows the drawing punch to pass down through the blank holder and draw up the shell. When the work has but little taper, a knock-out will be found necessary to remove the work from the die, but on tapered or flared work it will not be required.

A press of this kind is advantageous for what might be called "Hydraulic Press Work," that is, swelling out or distending a piece of work, such as an ice pitcher, sugar bowl or other work of this class, by filling the interior with water, or, better still, a piece of wax, and then giving it a blow with the punch which fills the upper part of the die in which the work is inclosed. The same idea can often be used with advantage in drawing up a shell when the punch does not properly fit the die, the work being partially drawn up at the first stroke, by filling the same with water and giving it a second blow, forcing the shell to fill the die perfectly; the water will, at the same time, turn to the color and, in fact, to about the same consistency of the fluid retailed in our city under the name of milk. Some of our readers can doubtless explain this phenomenon.

Speaking of the liability of injuring the fingers on a "drop," I saw an occurrence in the shop one day, which would go far towards proving that little or no pain is felt by the operator. in an injury of this kind. A man was bending up a piece of work with a very light blow, and which necessitated his putting his hand very close to the die; it was an old fashioned rope drop, and when the hammer had nearly reached the top of the up stroke, the rope broke, and down came the force, crushing as he thought, his entire hand, which was really very close to the hammer, but not between the dies at all. Quick as a flash the man caught his left hand in his right, and sinking back on a box, commenced to groan in great agony, until being encouraged to look at the injured member he gradually withdrew his right hand, thus disclosing to his astonished shopmates, who had gathered around him, that the left hand had sustained no injury. Such is the effect of imagination.

In setting up a drop-press, the old idea that it must be set on an elastic foundation, or, at least, the press itself should never be set directly upon a stone foundation without a layer of sheet lead or rubber in between, has been pretty well done away with, as the best method now practised is to set the base of the machine on the rock itself, cutting out a small hollow under the same to receive the dirt that invariably works to the center.

Watching an old Scotchman the other day, who was superintending the erecting of two 1 500 lb. "drops," which he was setting up in this manner, and knowing that he had had a life-long experience in this kind of work on both sides of the water, I said, "Ten years ago you would not have dared to do that."

"Hoot! mon, twa years ago a' wudna done it, but the waurld do move, and a' must move wi' it."

I send you these points, hoping that some other reader will take the matter up and tell us what he knows on the subject, so that we can compare notes; for as the old Scotchman said to me: "Nae ane head 'll ever hold it a', for before he gets it a', it be time he dies."

J. L. LUCAS.

MORE ABOUT FORCE FITS.

The amount of difference between the size of hole to be bored and the outside diameter of piece turned, to make a solid job when pushed together, is subject to several considerations. Every job intended for a forced fit should be a hole bored to a proper taper, and the piece or shaft intended to be forced on to it, should be exactly the same taper when turned and should fit the same before being forced together.

If straight holes and pieces are insisted upon, let it be borne in mind that when such fits are forced together, the hole is usually broached out in the act of pushing together. In such cases, it is by far the better way (when convenient to do so), to *shrink* the piece with hole on to shaft, proper allowance being made in size of each in boring and turning. In ordinary cases such as a fine grain cast iron hub, to be shrunk on a steel shaft, or *vice-versa*, especially if the steel or hard steel, allow .001 (one thousandth) of an inch per inch diameter. This is ample for a solid immovable fit, that is, if each is turned smooth and clean to size.

If both pieces are soft steel or coarse grain cast iron, then more allowance can be made; but the real kink of the job lies in the fact that an exact fit is obtained in boring and turning before the fitting occurs, and the holding fast together depends very much upon whether hole and piece are thus fitted and bear uniformly. To illustrate, our mechanical ruffian bores out a hole somewhat tapering; he turns his shaft straight to a given size, and if he doesn't warm up the shaft, instead of piece with the hole, he gives it a good rousing "warming up" and drops in on to shaft, then waits for it to cool off and stick. But it simply sticks at one end of the hole, while, perhaps, the other end is only in line contact. Sooner or latter that job gets loose.

The writer once repaired a 10-inch gear, as follows: the teeth (cast-iron) were fast getting thin and something needed to be done soon to replace them. I advised them to put on a machine steel ring and cut teeth in ring. It so happened that the hub arms, as well as the rim of gear, were amply large, so we trimed off the old teeth—and more, to give thickness below teeth on steel ring, and allowed (for a 9-inch shrink fit) .001 thousand of an inch per inch diameter, .009 inch in all, making size of ring when bored out, 8.991 inches. A nice black heat expanded the ring so that it dropped on and soon began to come to a bearing. It held fast—never to move in after use. That gear drove two others of smaller diameter at quite good speed, say 250 revolutions per minute. That was many years ago, but the steel gear (teeth were cut on ring, shrunk on) did first-class business.

In later years when I became the owner of a Pratt & Whitney Co. machine and tool catalog, I found that they were making standard locomotive wheel-center and tire-gauges, adopted by the American Railway Mechanics' Association, and we found on page 282 of said catalog, that for the shrinking of locomotive steel tire onto cast iron wheels that the ratio of allowance for said shrink fits (which by the way is a severe test for proper amount) closely approximates .001 per inch diameter: given thus:

A 38" wheel less .040"		" 56 " " .060"	
" 44 " " .047"		" 62 " " .066"	
" 53 " " .053"		" 66 " " .070"	

These gentlemen, the P. & W. Co. and the A. R. M. M. association are good authorities on this subject.

Concerning fits to be pushed on by hydraulic press, it is a decidedly wrong practice to bore and turn straight. I have known cases where holes have been bored out straight but the piece to fit the same turned tapering and the end entering hole rounded over as if to prevent broaching out in pushing on. But whether such pushing on is reckoned by tons or not, the whole scheme is wrong; and after the forcing is completed it cannot properly be called a forced *fit*.

F. W. CLOUGH.

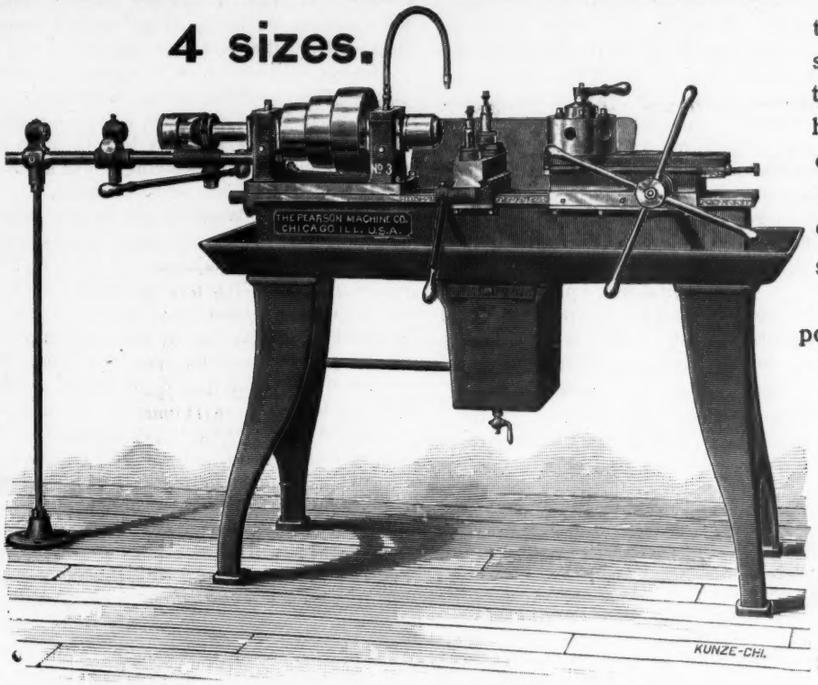
* * *

IN a little book I chanced to pick up I read: "Remember the strength of a chain is its weakest link." Just so. And how well this applies to everything we find ourselves enticed into doing in the mechanical line. We strengthen the frame till we are sure it will never give way to any applied strain, then make a spindle or something else, so weak that it is certain it will not stand up to its work. What has been the gain by strengthening the frame?

Screw Machines

4 sizes.

Our spindle bearings are adjustable vertically. Our separator filters the oil and can be removed instantly for cleaning.



Our new No. 6 Machine takes 2 1-4 in. stock through the wire feed; has improved chuck, which brings work close to head stock; and a new duplex power feed to turret slide which is a great time saver.

Watch this space for illustrations.

No. 3 Machine, 1 1-8 inch through wire feed. Weight, 1250 pounds.

The Pearson Machine Company,

31 West Randolph Street, Chicago, Illinois, U. S. A.

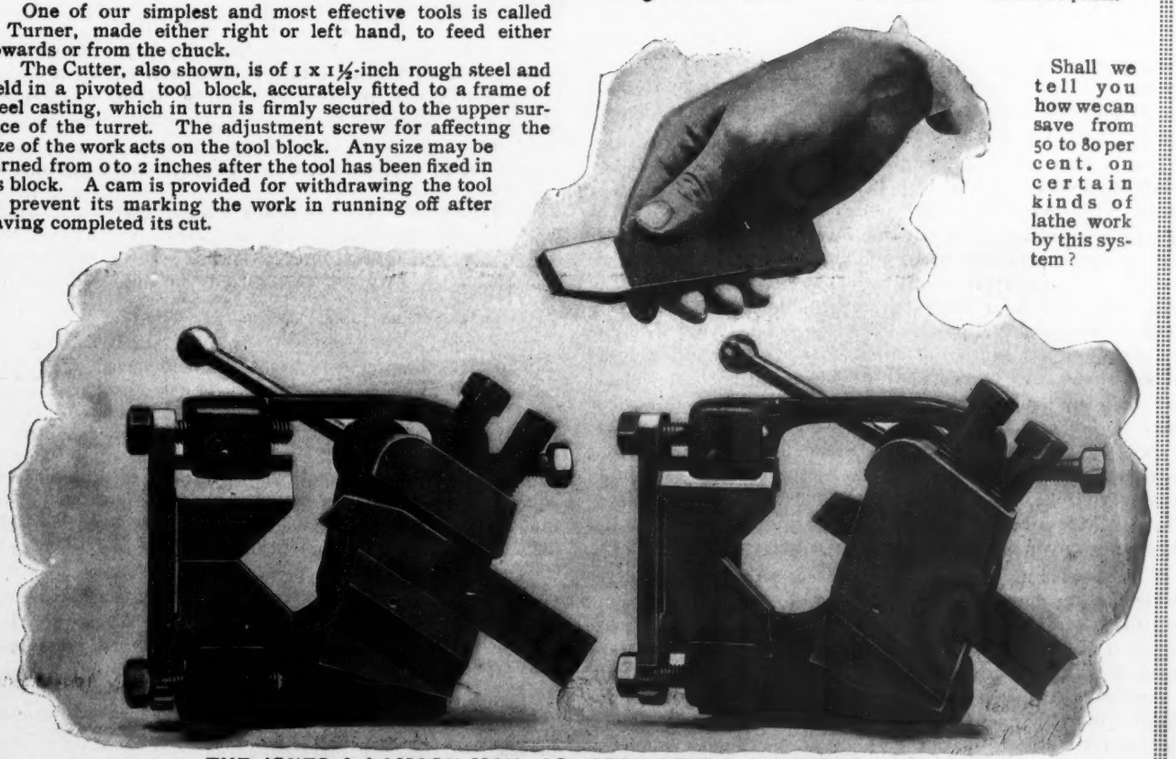
TURNERS AND CUTTERS.

A New Lathe System.—VIII.

See preceding issues of MACHINERY for detailed descriptions.

One of our simplest and most effective tools is called a Turner, made either right or left hand, to feed either towards or from the chuck.

The Cutter, also shown, is of 1 x 1½-inch rough steel and held in a pivoted tool block, accurately fitted to a frame of steel casting, which in turn is firmly secured to the upper surface of the turret. The adjustment screw for affecting the size of the work acts on the tool block. Any size may be turned from 0 to 2 inches after the tool has been fixed in its block. A cam is provided for withdrawing the tool to prevent its marking the work in running off after having completed its cut.



Shall we tell you how we can save from 50 to 80 per cent. on certain kinds of lathe work by this system?

THE JONES & LAMSON MCH. CO., SPRINGFIELD, VERMONT, U S. A.

FOREIGN REPRESENTATIVES—HENRY KELLEY & Co., 26 Pall Mall, Manchester, England.
M. KOYEMANN, Charlottenstrasse, 112 Dusseldorf, Germany; representative for Germany, Belgium, Holland, Switzerland and Austria-Hungary.

HOW AND WHY.

A COLUMN INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST. GIVE ALL DETAILS AND YOUR NAME AND ADDRESS, WHICH WILL NOT BE PUBLISHED UNLESS DESIRED.

1. G. A. writes: 1. I should like to know the length of the longest planer. I have been told that the Niles Tool Works can plane a piece 150 feet long without coupling two platens together. Can you give me any information on the subject? *A.* The Niles Tool Works inform us that they do not know of any planer as long as 150 feet, nor do they consider such a length practical. Neither do we, nor can we think why it should be necessary to plane such a length. The Powell Planer Company, of Worcester, Mass., have a large planer which will plane 40 feet long on a pinch. If anyone knows of a longer planer than this we should be glad to hear from him. 2. Is the ordinary bed planer used for such work, or do they use the side planer with traveling head? *A.* The ordinary type of planer is used, unless you refer to plate planers, where any length can be planed by shifting the work.

2. R. W. writes: I want to change the exhaust from my engine, turning it into the chimney to avoid the noise it makes. Is there any objection to doing so? *A.* We assume your chimney to be of brick. The danger of exhausting into a brick chimney is that of slowly destroying the mortar in which the bricks are laid You might deaden the noise by using an exhaust pipe head at the end of the exhaust pipe.

3. J. E. G. writes: I have some small pieces of finished cast iron that I should like to harden on the surface. Can I do so? *A.* You may, perhaps, accomplish your purpose by making a hardening bath in the proportion of 10 gallons of clean, preferably soft, water to which is added 1½ pints of oil of vitriol and 6½ ounces of saltpetre. Heat and dip the iron as if it were a piece of steel. If it does not harden add a little more of both oil of vitriol and saltpetre.

4. R. L. B. writes: The engine I am running has a cylinder 12″ diameter and a port 11″ long. The lead is $\frac{1}{32}$″. What will be the effect of increasing the lead to $\frac{1}{16}$″? I ask because the eccentric is keyed to the shaft and it is considerable trouble to shift it? *A.* If there is a fair amount of compression and the port is of fairly generous length the effect of increasing the lead as you suggest will probably not be noticeable. If there is but little compression it will be well to increase the lead. If the port were short, it would also be well to increase the lead. There is a good deal of misapprehension as to the effect of lead that comes from not stopping to consider that when lead takes effect the valve is moving faster than the piston.

5. L. B. writes: I am running a 75 HP. engine and it will do the work required at 65 pounds boiler pressure, cutting off at ¼ stroke. I have read on what appears to be good authority that ¼ stroke is early enough cut-off in a high pressure engine, for good economy, so I have been running with that pressure. Two weeks ago, as an experiment, I increased the pressure from 75 to 80 pounds and feel quite certain that the boiler steams more freely and that less coal is required to keep up steam. Am I wrong in the matter or is the authority wrong? Of course, with the higher pressure the cut-off is considerably before ¼ strike. *A.* Neither is necessarily wrong. We have no doubt that you are right in believing that you save steam by using the higher pressure, notwithstanding too early cut-off. If your engine were to be more heavily loaded, so that with the higher pressure the cut-off was at ¼ stroke, you would probably find that you were doing the work at less cost per unit of work than now. Both you and the authority you refer to may be quite right.

6. F. K. asks us to give him the latest formula for counterbalancing locomotive driving wheels. *A.* No system of balancing can take care of all of the effects of the reciprocating parts which it would be desirable to take care of if we could. Any method at best is a compromise or an approximation. Prof. Lanza, who has devoted much attention to the matter, states that the following method has been used by a number of builders: For the main drivers, make the weight of the counter-balance = ½ wt. of back end of connecting-rod + ½ wt. of front end of connecting-rod, piston, piston-rod and crosshead. For the coupled wheels, wt. = ½ wt. of parallel-rod + ½ wt. of front end of main rod, piston, piston-rod and crosshead. He further states that the centers of gravity of these weights should be at the same distance from the axle as the crank pin, which they never are in practice, and allowance must be made for this as follows: Suppose that the counter-weight is to be placed in the rim and that the distance of its center of gravity from the axle is known. To find the correct weight, multiply the weight as calculated above by the length of the crank and divide by the distance from the center of gravity of the weight to the axle.

Another method which is sometimes used is as follows: 1. Balance the revolving parts. 2. Divide ⅔ of weight of reciprocating parts between all the wheels equally. In obtaining the reciprocating parts, consider half of main rod as reciprocating and the other half as revolving. The same correction as before for distance from center must be made.

7. T. A. asks: What should be the thickness of a cast iron hydraulic cylinder to withstand a pressure of 5 to 15 tons, the cylinder to be 12″ diameter and 15″ long? *A.* We understand you to mean that the total pressure on the ram or piston, and against which it must work, is 5 to 15 tons. Cast iron suitable for such a cylinder should have a cohesive strength of 18 000 pounds per square inch of rectional area. To provide for safety submit it to no more than ⅓ of this, or, 18 000 ÷ 3 = 6 000 pounds. The greatest pressure (15 tons) is 15 × 2 000 = 30 000 pounds. The area of a 12″ cylinder is 113 square inches; the pressure per square inch is 30 000 ÷ 113 = 265 + pounds. Apply the following rule: Multiply the pressure per square inch by the radius (half the diameter) of the cylinder in inches and divide the product by the safe cohesive strength of the material (6 000 pounds). The quotient will be the thickness in inches. 265 × 6 = 1 590 and 1 590 ÷ 6 000 = .265; the thickness is a little more than ¼ inch. This is too thin to cast such a cylinder. Make it at least ½″ or ⅝″ thick. If you mean 5 to 15 tons per square inch, a formula for thick cylinders which is very generally accepted is: $T = \frac{R \times P}{S - P}$, in which expression T = thickness of metal, in inches; R = radius of inside diameter; P = pressure per square inch and S = the cohesive strength of the material = 18 000 pounds. This may be put in the form of a rule, as follows: Multiply the inside radius of cylinder by the pressure per square inch and divide the product by the cohesive strength of the material less the pressure per square inch. The quotient will be the thickness of cylinder walls $\frac{6 \times 10\,000}{18\,000 - 10\,000} = 7\frac{1}{2}$, which, in inches, is the thickness of metal that will just put the strain and resistance in equilibrium; that is, with iron having a cohesive strength of 18 000 pounds a 12″ cylinder having a thickness of 7½″ is, when subjected to a pressure of 10 000 pounds per square inch, just at the point of bursting. But the factor of safety should not be less than 2, which is low. With this factor of safety (2) we have S = 18 000 ÷ 2 = 9 000; then $\frac{6 \times 10\,000}{9\,000 - 10\,000}$ The divisor would be a minus quantity (— 1 000). It is evident that so large a factor of safety cannot be employed. Let it be 1½. Then S = 18 000 ÷ 1½ = 12 000 and $\frac{6 \times 10\,000}{12\,000 - 10\,000} = 30$ the thickness of metal, in inches, with a factor of safety of 1½, and the factor of safety is then too low. For 15 tons (30 000 pounds), we have $\frac{6 \times 30\,000}{18\,000 - 30\,000}$. It is evident that you cannot make a cylinder of cast iron that will withstand this pressure, and equally evident that it is not practicable to make cylinders of that material to be subjected to a pressure of 5 tons per square inch. Nor would it be practicable to make a cylinder of cast steel to withstand a pressure of 15 tons per square inch. The elastic limit of a good steel casting may be taken at 36 000 per square inch. This pressure or strain should not be very closely approached. Employ a factor of safety of 2 for a pressure of 5 tons (10 000). You may use a steel cylinder, letting S = 36 000 ÷ 2 = 18 000. Then $\frac{6 \times 10\,000}{18\,000 - 10\,000} = 7.5$, the thickness in inches.

* * *

IT has been left for a woman, Madame Zehof, to build the first street railway in Russia, which will be an electric line. Up to the present time it is said that there is no street railway of any kind in the whole empire.